Diagonal turbine laboratory development for medium heads (25 – 100 m)

Small Hydropower (SHP)

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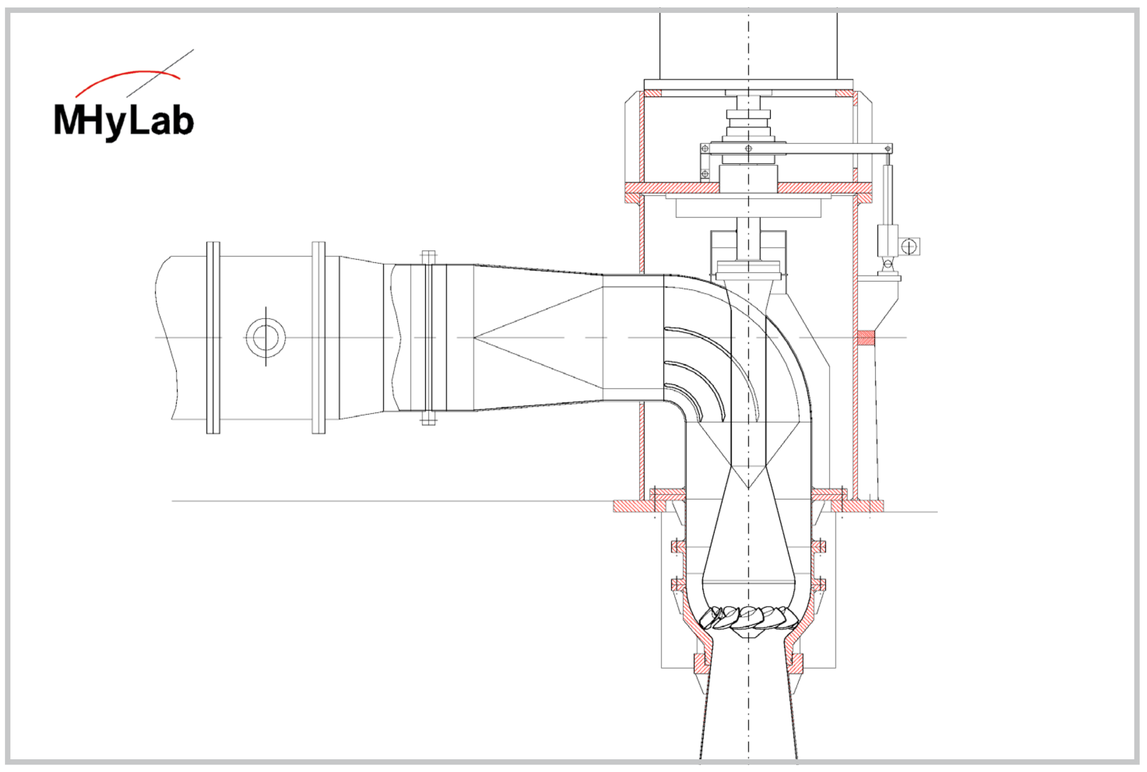
The project aims at designing a turbine especially optimized to SHP medium-head sites, based on modelling and laboratory tests. This infers the maximisation of the electric production on a long term, while reducing the investment and operating cost. Such objectives are especially environment friendly, as the optimal use of water resource to produce green electricity will be guaranteed.

Statement of the problem

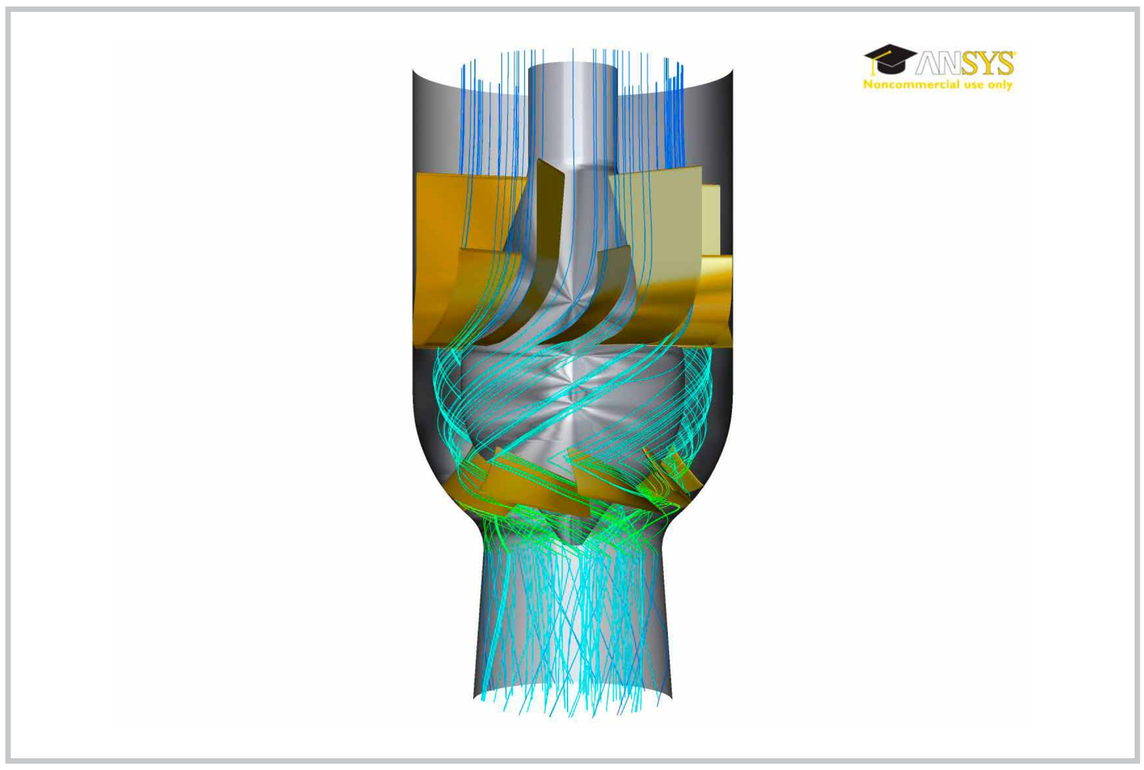
Among renewable energies, SHP has still a bright future: the European remaining potential is estimated at 38 TWh/year, with about 30% of medium-head sites, including the turbining of reserved flows at the foot of large dams. Moreover the electric production of such sites (rehabilitated or new ones), usually equipped with Francis turbines, will be optimised thanks to laboratory-developed Diagonal turbines, which allow high efficiencies on wider ranges of discharge and head.

Goals

- To develop, on the basis of a CFD calculation, a turbine scale model, to be set on MHyLab's test bench, so as to valid the chosen options and to develop an optimal hydraulic profile.
- To cover the head range between 25 and 100 m, for a maximal output of about 1 MW, by developing configurations with 8, 10 or 12 adjustable blades, with a mechanical efficiency higher than 90%.
- To transfer the scale model design and performances to the prototype, thanks to the systemization method: the prototype will be especially designed for the site to equip.
- To develop a turbine design, which cost/benefit ratio is higher than the «standard» products.
- To guarantee the hydrodynamic operation of the turbines.
- To allow a reduction of the operating costs.
- To supply an efficient, reliable and guaranteed technology to independent manufacturers.
- To allow a large dissemination of R&D results.



Hydraulic profile of the diagonal turbine developed by MHyLab.



Modelling of the central part of the diagonal turbine.

Results / Outlook

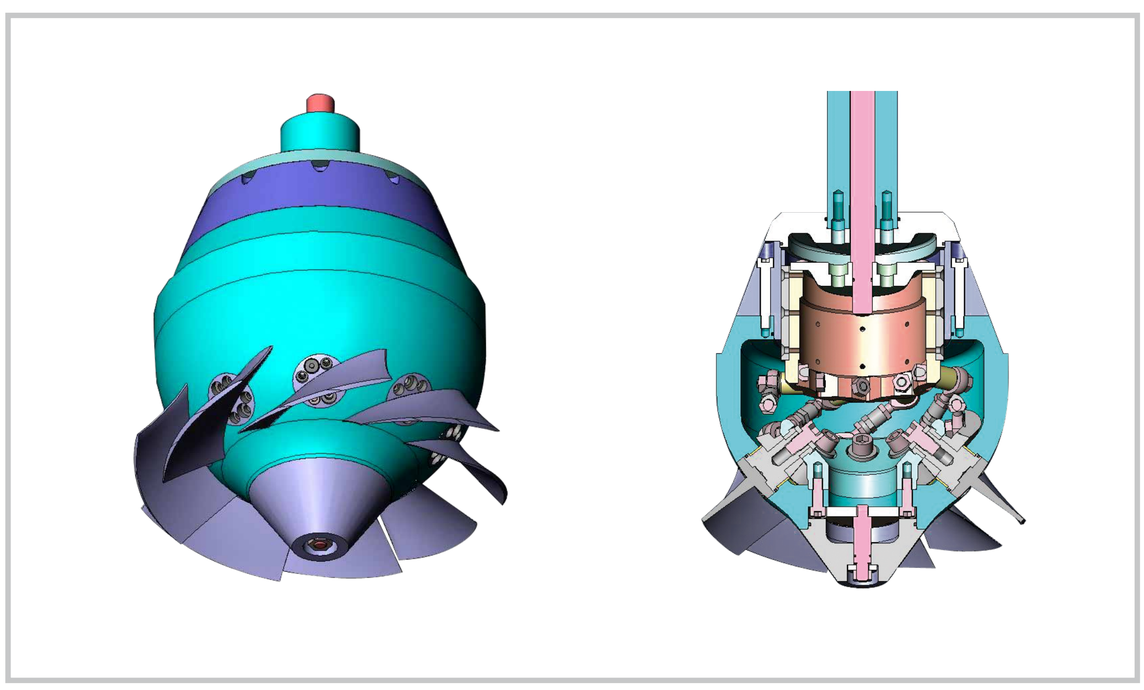
State of the art: rare operating ones, used as pump-turbines in the large hydropower sector. **Base:** previous R&D programme led by MHyLab on axial turbines (Kaplan type), using the same saxo shape.

Current tasks:

- Runner modelling to optimise the vanes and blades dimensions, especially regarding cavitation behaviour while maximising the whole turbine efficiency between 25 and 100 meters.
- Mechanical design of the 12-blade scale model, and particularly the inclined-blade regulation system.

Next tasks:

- Manufacturing of the 8-blade scale model to be set on the test bench at the beginning of 2010 to achieve efficiency and cavitation tests.
- Then, 12-blade and 10-blade laboratory development.



Runner and 8 inclined blade regulation system.

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