Facts of the project

Project start:	October 2008
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Partner:	Services Industriels de Genève, Swiss Federal Office for Energy
Further information:	www.mhylab.ch

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

Small Hydropower (SHP)

MHyLab, Mini-hydraulics Laboratory of Montcherand • Lucerne University of Applied Sciences and Arts, HSLU

supported by:

swisselectric research

Seilerstrasse 3
Postfach 7950
CH-3001 Bern

T +41 (0)31 380 10 64
F +41 (0)31 381 64 01
research@swisselectric.ch

atel BKW CKW EGL EOS NOK

swisselectric research

www.swisselectric-research.ch

MHyLab

Lucerne University of Applied Sciences and Arts
HOCHSCHULE LUZERN
Technik & Architektur
CC Fluidmechanik & Hydromaschinen

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 the 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.

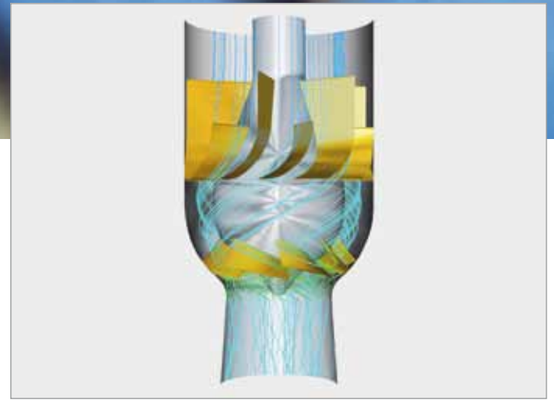
Goals

- 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 meters, 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%, while presenting an excellent behaviour exempt from cavitation erosion.
- 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, as achieved for large units.
- 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.

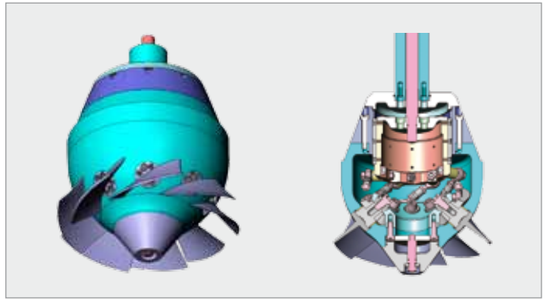
Results and Outlook

A review of the state of the art concerning Diagonal turbines has quickly shown that the rare operating ones are used as pump-turbines in the large hydropower sector. Therefore the project bases itself mainly on the previous R&D programme led by MHyLab on axial turbines (Kaplan type), using the same saxo shape. The modelling of the runner is currently achieved so as to optimise the vanes and the blades dimensions, especially regarding cavitation behaviour while maximising the whole turbine efficiency between 25 and 100 meters.
The mechanical design of the 12-blade scale model has been also studied, and particularly the inclined-blade regulation system.

Both tasks will lead to the 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 will follow the 12-blade and the 10-blade laboratory development.



Modelling of the central part of the Diagonal turbine.



Runner and 8 inclined blade regulation system.