SMALL HYDROPOWER
R&D Strategy and Needs

European Thematic Network
on Small Hydropower
TN – SHP
http://www.esha.be/ukthematic.htm

Workshop Agenda

- 17h30 Welcome and Introduction
  - Vincent Denis, MHyLab, Switzerland
- 17h40 What is the thematic network on small hydropower ?
  - Maria Laguna, ESHA, Belgium
- 17h50 Strategy document on R&D on small hydropower
  - Vincent Denis, MHyLab, Switzerland
- 18h00 Civil Work : Refurbishment of old plants: an interesting potential
  - Jonas Rundqvist (SERO, Sweden)
- 18h20 Mechanical aspects : Is R & D in small-turbine design still needed
  - Vincent Denis, MHyLab, Switzerland
- 18h40 Fast evaluation of the cost of a SHPP, the POPEHYE software
  - Erik Bolleart, EPFL-LCH, Switzerland
- 19h00 Discussion
- 19h20 Coffee and informal discussion

Goal of the workshop

- To present the Thematic Network activities
- To present the Strategy document on R&D on small hydro power
- To present some ongoing projects
- To lead a discussion on the R&D needs
- To receive a feed back on the strategy document.

European strategy document for RD&D in small hydropower.

Porto
19th October 2004

Target of the strategy document

The target of this document is to present an overview of small hydro in Europe, which specify :

- The development potential
- The obstacles likely to be encountered,
- The state of the market and of industry,
- The state of the environmental integration
- The state of RTD.

Why a strategy document ?

Maturity of large hydro has held the false opinion that there is no much scope for technical development and improvement in any hydropower system.

There is however considerable scope for :

1. Designing and developing material and construction procedure aiming to **reduce** strongly the **environmental impact** of SHPs (in other words, how the technological development can help the environmental integration of SHPs)
2. Improving the cost-effectiveness of SHPs, especially in low head developments, both through technical and non-technical innovations.

Content of the European strategy document.

- Necessity of a European RTD strategy in small hydro power.
- European strategy definition.
- Priorities and objectives.
- Means to reach the objectives.

Necessity of a European RTD strategy in small hydropower.

- Description of small hydropower plant
- Development potential
- Obstacles to potential development
- Specific cost of small hydro
- State of the industry
- State of RTD
- Why RTD in small hydro is necessary

European Strategy

- General topics
- General design
- Civil work
- Electromechanical equipment
- Control and monitoring systems
- Environmental integration

Priorities and objectives

- General topics
- General design
- Civil work
- Electromechanical equipment
- Control and monitoring systems
- Environmental integration
- Technical priorities
- Non-technical priorities

Who can make an input in the document ?

- The engineering group members
- The Thematic Network partners
- The workshops delegates
- Anybody involved in small hydro via the web site

How to receive the strategy document ?

- Ask for a free registration as a member of the network :

  www.esha.be/ukthematic.htm
- Or e-mail :

  maria.laguna@esha.be

Is R & D in small-turbine design still needed?

An example of ongoing laboratory development based on systemisation.

Vincent DENIS - MHyLab
CH - 1354 Montcherand
www.mhylab.com
info@mhylab.com

Small hydro power plant

A small hydropower plant is a plant which, for technical and economical considerations, must not be the geometrical reduction of a large one

Small hydro development

The cost of developing a test model is of the same order of magnitude as that of a complete small hydro turbine

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Independent manufacturers of small hydro turbine

cannot afford this laboratory work

Small hydro and high efficiency

High efficiency is important even for small hydro, because :

- The efficiency mirrors optimal hydrodynamic performance
- Guarantee the future production and the turbine reliability and operation
- The efficiency required for one 100 MW turbine is no less justified when dealing with fifty 2 MW turbines.

Output control at site

- Not easy to implement and costly
- Method frequently unsuited to small installations
- Always questionable
- Generally no possibilities to improve the turbine if guarantees are not reached
- Penalties never compensate for the loss of production

Output control - Laboratory tests

- Tests on turbines geometrically similar to the prototypes
- Transposable results are obtained (according to international standards)
- Possibility to correct the possible shortcomings before the prototype is built
- High cost

Succes criteria

The key words for a successfullly project are :

- Simple construction to ensure economical and constructional feasability for SME
- High energy efficiency
- Maximum reliability ans easy maintenance

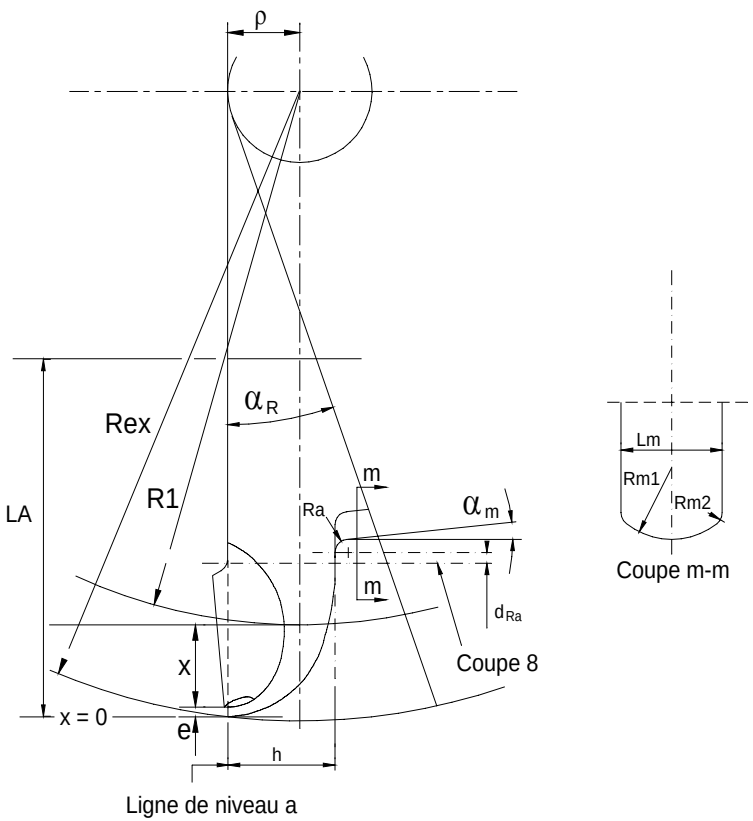
The Systematisation Method

- Entire parameterisation of the turbine's hydraulics.
- Test of the behaviour and performances as a function of the parameters.
- Offers the possibility to design individually each new turbine in function of the exact characteristics of the site to equip.
- Same efficiency and performance guarantees as for large hydro, even for Pm < 1'000 kW

The Systemisation method (Basic principle)

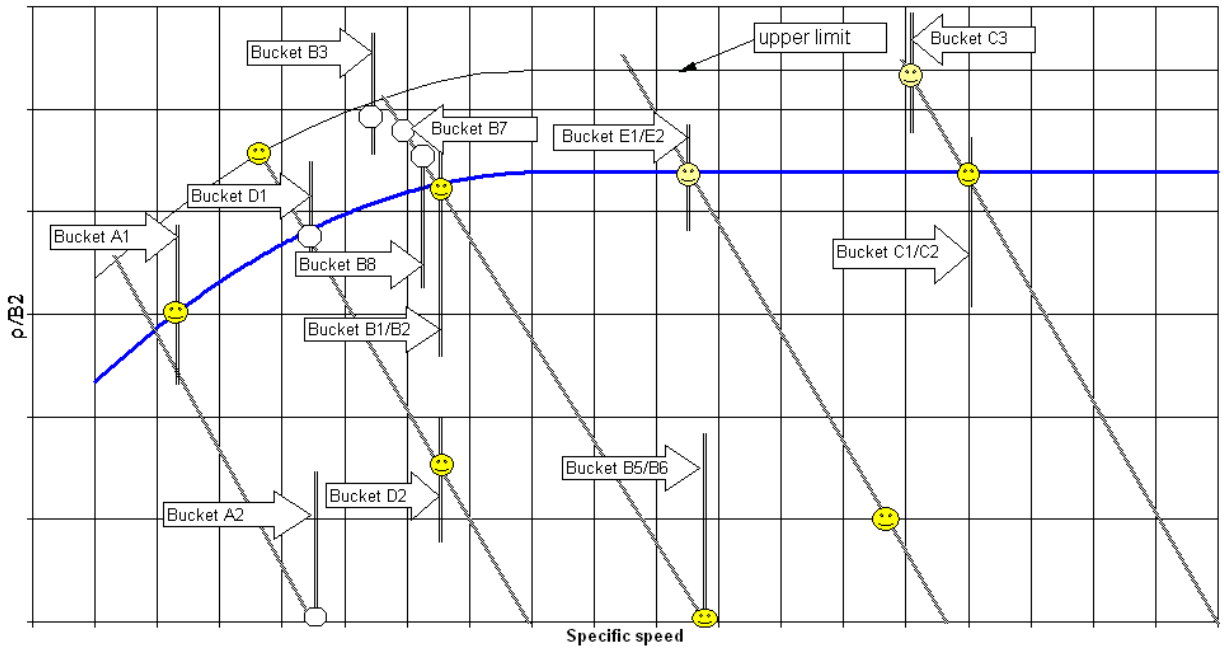
- Simplification of hydraulic forms, and use of commercially available parts.
- Measure of the impact of these simplifications on the test bench.
- Direct or indirect parameterisation of all hydraulic forms, function of the site's data.
- Development of mathematical and computer tools.

The Systemisation method (Presentation of the process)



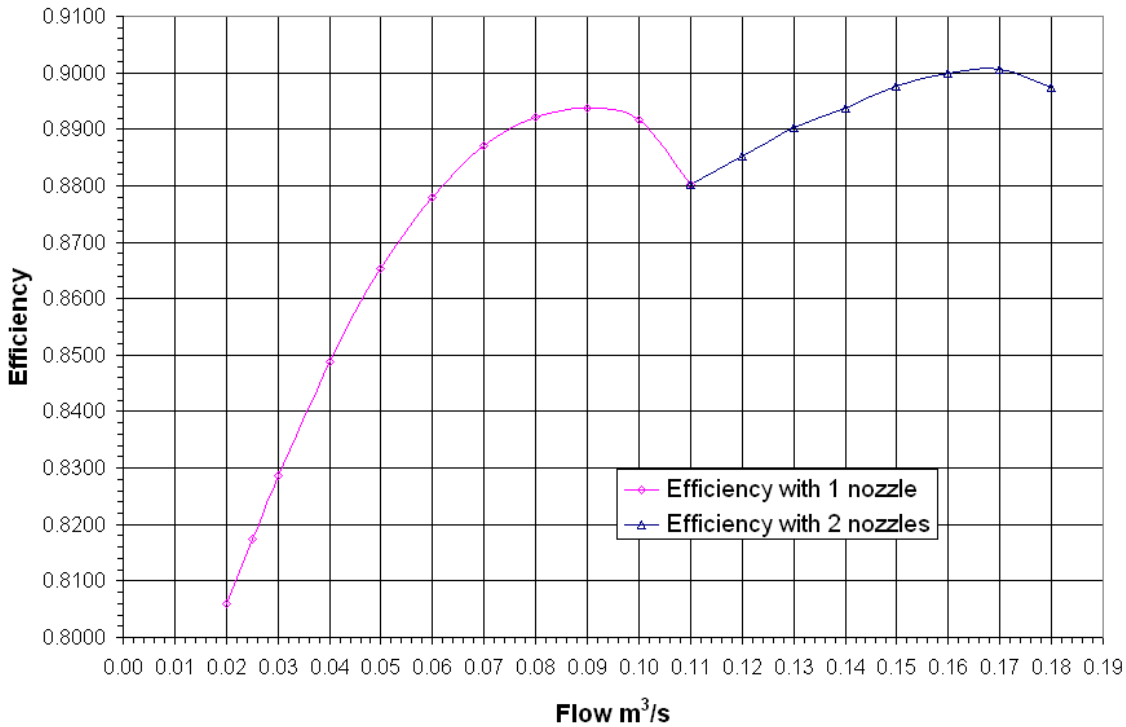
The first step consists in determining within what specific-speed limits, a given bucket topology can adapt to the flow by varying runner construction parameters.

The Systemisation method (Presentation of the process)



Variation of the eccentricity ρ of a Pelton runner in function of the specific speed (principle diagram)

Performance guarantees

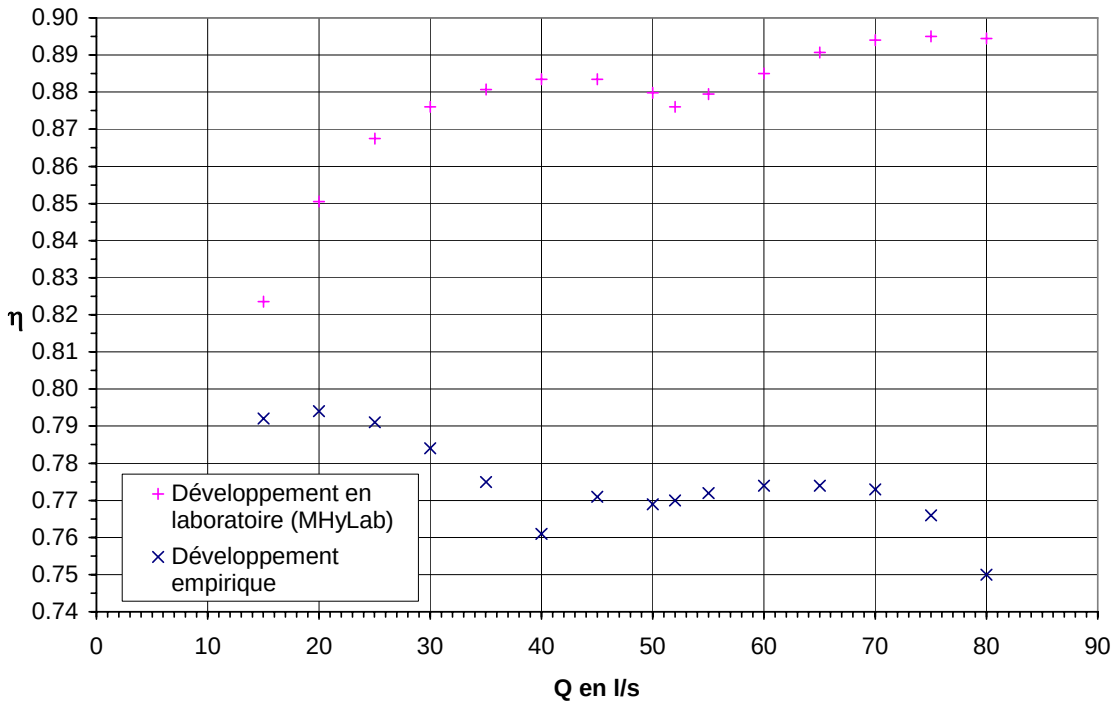


Efficiency guarantees (from laboratory tests), for La Rasse small HPP

Advantages of the method

- Turbine simple to be manufactured and maintained
- Optimal Hydrodynamic performance(high degree of operation security)
- Respected efficiency and power guarantees
- Cost savings on design
- Turbine delivery-time reductions
- Perfect compliance of the machine to the site's characteristics.

Advantages of the development in the laboratory

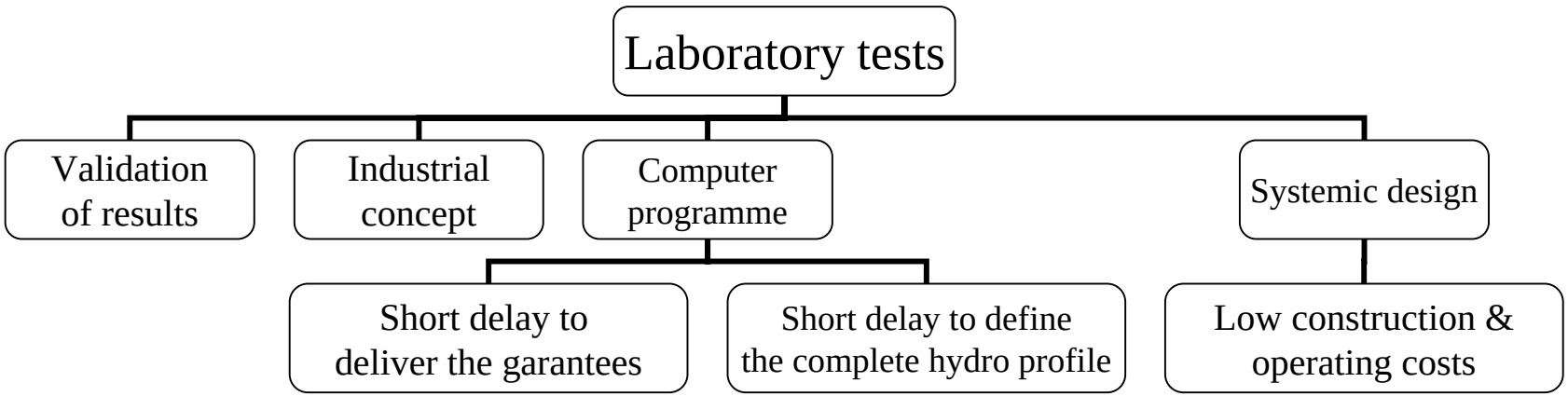


- 1 Pelton turbine, 2 nozzles
- H_n : 479 m
- Q_{max} : 180 l/s

Small HPP Pas-du-Lein (CH)

- 1 Pelton turbine, 2 nozzles
- H_n : 299 m
- Q_{max} : 180 l/s
- $P_{méc\ max}$: 470 kW
- Manufacturer : GASA SA (Switzerland)

Some R&D objectives



To provide small independent turbine **manufacturers** with an **efficient and guaranteed technique in a short delay, and with low costs**.

Conclusions

- Important work is performed to develop systemisation method.
- As for many other fields (electical equipment, control and monitoring systems, civil work, these examples show that R&D is still needed for small hydro.