28th IAHR Symposium on
Hydraulic Machinery and Systems
July 4-8th, 2016
Grenoble (France)

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Foreword

The 28th IAHR Symposium on Hydraulic Machinery and Systems was held in July 4th-8th 2016, Grenoble, France. Considered as the cradle of the hydroelectricity in France, the French Alps region is one of the most dynamic, innovative regions in France and products more than 40\% of the country hydroelectricity. Since Aristides Bergès and the concept of “houille blanche” (white coal) in the end of XIX century until now, the hydropower in Grenoble is a long and interesting history.

This Symposium, organized jointly by the Grenoble Institute of Technology and by the SHF (French Hydraulic Society) assembled 330 delegates, from 32 countries, including many PhD students’ presentations and contributed to the perpetuation of this beautiful story.

183 papers were selected by the Scientific Committee and presented during the conference in a plenary session and three parallel sessions. The scientific program included two specialized workshops:

- The first one concerned the PSP (Pumped Storage Plants)
- The second one was devoted to “hydro-abrasive erosion”

The symposium allowed for very good scientific and technical exchanges between delegates from Industry (47\%) and from University (53\%). It also brought together students, young researchers and experienced professionals.

A selection of 169 papers is published in this volume of the IOP Conference Series: Earth and Environmental Science.

Pumps and turbines of various types, sizes and for a variety of usefulness were of course in the core of the symposium. Fluid mechanics remained the dominant point of interest. Most developments that have been presented concern the use of CFD for the efficient analysis of flows within the machines with regard to more and more complicated situations especially associated to: unsteady phenomena, instabilities, off-design, transients, cavitation. There is still a need for experimental developments in order to provide detailed data bases for the validation of numerical models and for the estimation of uncertainties associated to numerical simulation.

Of course, all what concerns the effects of interactions between machines and systems remains also in the core of the symposium. Here again, most of the presented papers in the field concern the development of accurate numerical approaches with efforts regarding the experimental validation especially about the complexity of the systems and the possible occurrence of multiphase flows and associated problems. One important topic concerns the accurate extrapolation from reduced model to prototype.
Furthermore, it is clear that interactions of fluid mechanics with other scientific or technical disciplines become a major point of interest, regarding especially:

- Effects of fluid flow, especially with cavitation but also when sediments are present in the flow, on material erosion, a problem of great importance for machines life cycle.
- Fluid structure interactions with reference to vibration problems and also damage and failure of structures: a special attention to risk, safety and lifetime prediction was discussed during these sessions.
- Optimal design of machines, of course a very important topic for pumps and turbines manufacturers.
- Development of sustainable hydropower, with presentations regarding various types of machines especially for Micro and even Pico-hydropower plants
- Examples of various problems linked to pumped storage plants, with especially environmental, economical and even contractual aspects.

With the help of university and industrial partners, we did our best to organize this symposium and hope that delegates appreciated it.

Professor Regiane Fortes Patella

Grenoble Institute of Technology, LEGI Laboratory
Chairwoman of the Organizing Committee
28th IAHR Symposium on Hydraulic Machinery and Systems
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The Organizing Committee congratulates the authors who prepared the presented papers. We also greatly appreciate the careful readings of the papers and valuable comments by the members of Scientific Committee.

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Plenary session
Pumps.I, II, III, IV
Pelton turbines
Kaplan turbines
Pump turbines.I, II
Bulb and propeller turbines
Fluid/Structure interactions.I, II
Damage and failures.I, II
Vortex rope.I, II
Cavitation.I, II,
Unsteady flow phenomena in hydraulic machines
Systems.I, II, III, IV
Computational and experimental techniques. I, II, III, IV, V
Design and optimization
Pressure fluctuations
Draft tube / Vibrations
Sustainable Hydropower.I, II, III

Workshop Hydro-abrasive Erosion
Workshop Pumped Storage Plants
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The International Association for Hydro-Environment Engineering and Research (IAHR), founded in 1935, is a worldwide independent organization of engineers and water specialists working in fields related to the hydro-environmental sciences and their practical application. Activities range from river and maritime hydraulics to water resources development and eco-hydraulics, through to ice engineering, hydro-informatics and continuing education and training.

The IAHR-Committee on Hydraulic Machinery and Systems deals with the advancement of technology associated with the understanding of steady and unsteady flow characteristics in hydraulic machinery and conduit systems connected to the machinery. The technology elements include the fluid behavior within machine components, hydro-elastic behavior of machine components, cavitation, and two phase flow in turbines and pumps, hydraulic machine and plant control systems, the use of hydraulic machines to improve water quality, and even considerations to improve fish survival in their passage through hydro plants. Included in two phase pumping are gas oil pumps and sand laden water. Because model tests and laboratory tests carried out in laboratories must be scaled down from the prototypes, studies of size and pressure scale effects are also a central research field. The research work in the Committee forms the basic study for the IEC standards code dealing with hydraulic machinery for hydroelectric power plants.

The main emphases of the IAHR Committee on Hydraulic Machinery and Systems are to stimulate research and understanding of the technologies associated with hydraulic machinery and to promote interaction between the machine designers, machine users, the academic community, and the community at large.

www.iahr.org
The Société Hydrotechnique de France (SHF) is a nonprofit association founded in 1912. It is working at the forefront and crossroad of research and industrial processes, and carries out its activities in the field of water:

- various aspects of resources management,
- everyday use for human needs, energy, agriculture, industry and transport, including environmental impact
- natural phenomena related to hydrology, meteorology, flood, low flows and drought,
- and the more general field of fluid mechanics of all types, industrial applications and hydro machinery.

The SHF seeks to foster and develop scientific knowledge and understanding in all fields related to water resources and hydrotechnical sciences. Acting as a hub and meeting point, through conferences, working groups and its publications, it aims at increasing scientific and technical dialogues and exchanges among researchers, engineers, national and local services, industrials, students …

The SHF organizes 5 to 7 conferences, bringing together up to 1000 participants each year, thereby creating a sense of community among its members, on the various issues at stake.

The Hydraulic Machines and Cavitation Section, is one part of the Hydrotechnology and Fluid Mechanics Division; it brings together the European community in the field of hydraulic and aeraulic machines and of cavitation. Every 18 months a joint open seminar is organized in order to promote exchanges and to review ongoing works, to identify emerging needs in terms of R&D, and to launch joint projects occasionally.

SHF is the publisher of La Houille Blanche, International Water Journal, a reference for water engineers and researchers since 1902. It is published every two months, with articles both in French and English. The targeted audience encompasses everyone interested in hydro environment, engineering and research.

www.shf-hydro.org/www.shf-lhb.org
IOP Conference Series: Earth and Environmental Science vol.49

has been organized as

- turbines
  - Pelton turbines
  - Kaplan turbines
  - bulb and propeller turbines
- pumps
- pump turbines
- systems
- computational and experimental techniques
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  - fluid structure interactions
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  - unsteady flow phenomena in hydraulic machines
  - vortex rope
  - pressure fluctuations
  - draft tube / vibrations
- cavitation
- sustainable hydropower
- pumped storage plants
- hydro-abrasive erosion