



ACADEMIC AND SCIENTIFIC AGREEMENT

BETWEEN

EPFL, ÉCOLE POLYTECHNIQUE FÉDÉRALE

DE LAUSANNE,

AND

UPT, POLITEHNICA UNIVERSITY OF

TIMIȘOARA

PROF. FRANÇOIS AVELLAN VISIT AT UPT,

OCT.29-NOV.03, 2005



**National Center for
Engineering of Systems
with Complex Fluids**



Within the Academic and Scientific cooperation agreement between Ecole polytechnique fédérale de Lausanne (EPFL) and University "Politehnica" of Timișoara (UPT), started in 2002, Professor François Avellan is visiting the Politehnica of Timișoara for the period Oct.29-Nov.03 2005.

1. Scientific Research

- 1.1. Within the program "Scientific Co-operation between Eastern Europe and Switzerland" (SCOPEs), the Swiss National Science Foundation has approved for funding our Joint Research Project entitled "***Turbomachinery swirling flow optimization and control with technology of magnetorheological fluid systems***", with a budget of 59500 CHF. The project will start at January 1st, 2006, with duration of 36 months. A kick-off meeting for this project will be held at the National Center for Engineering of Systems with Complex Fluids from UPT, on Oct.31st, 2005, with the following agenda:
 - Project management: regulations concerning NSF grants and administrative aspects, EPFL-UPT research contract, financial reports and progress reports.
 - Presentation of magnetorheological fluids (typical magnetic, rheologic, and magneto-rheologic properties), advantages and current limitations.
 - Presentation of magnetorheological devices: design principles, applications.
 - Research plan details for designing, manufacturing and testing magnetorheological devices for swirling flow control.
 - Numerical investigation of 3D unsteady swirling flows in hydraulic turbines: choosing a turbine model for numerical investigations (the same model will be used for experimental validation on the test rig), establish the operating regimes to be investigated numerically.
- 1.2. For the 23rd IAHR Symposium on Hydraulic Machinery and Systems, Yokohama, Japan, 2006, we prepare and submit a paper abstract: R. Susan-Resiga, G.D. Ciocan, S. Muntean, I. Anton, F. Avellan, "*Numerical Simulation and Analysis of Swirling Flow in the Draft Tube Cone of a Francis Turbine*".

2. Education

- 2.1. Meeting with the Politehnica University board (Prof.dr.ing. Nicolae Robu, Rector, and Prorectors), Nov.01, 2005: evaluation of the ongoing academic and scientific cooperation between EPFL and UPT, international student exchange program, possibilities of further expanding the cooperation.
- 2.2. Meeting with Prof.dr.ing. Nicolae Neguț, Dean, and faculty from the Mechanical Engineering School, Nov. 02, 2005: educational strategies at EPFL and UPT in engineering science, and mechanical engineering in particular, development of master and PhD programs.
- 2.3. Student exchange program: meeting with candidate students Stroiță Cătălin and Moisă Irina, for diploma projects 2006 at EPFL.

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1.1. Meeting with the UPT research team involved in the Joint Research Project "Turbomachinery swirling flow optimization and control with technology of magnetorheological fluid systems"

Monday, Oct. 31, 2005, 10:00 a.m.

Participants: **Prof. François Avellan**, Ecole polytechnique fédérale de Lausanne, Deputy Dean of the School of Engineering, Director of the EPFL Laboratory for Hydraulic Machines, **Prof. Ioan Anton**, member of the Romanian Academy, **Prof. Romeo Susan-Resiga**, Head of the National Center for Engineering of Systems with Complex Fluids, **Dr. Ladislau Vekas**, **Dr. Călin Popa**, **Dr. Sebastian Muntean**, **Dr. Sandor Bernad**.

Prof. Resiga is presenting the project tasks, and the corresponding deliverables. He introduces the members of the UPT-NCESCF research team.

Dr. Vekas is presenting the magnetorheological fluids, with discussions on their specific properties relevant to the project. Dr. Popa presents specific applications for magnetorheological dampers, with main technical characteristics. Dr. Vekas has presented the experimental facilities at UPT-NCESCF (magnetometer, rheometer, magneto-rheological cell) that will be used in the project for complex physical characterization of the magneto-rheological fluids to be used.

Prof. Avellan has summarized several strategies for controlling the unsteady swirling flow in the hydraulic turbine draft tube. There are three main approaches: acting on the pressure fluctuations at the nodes of hydraulic path, use the "brute force" by bypassing a fraction of the turbine flowrate using a rotating valve to inject-it in the draft tube, use a new control technique to address directly the source of flow instability.

Prof. Anton was exploring the possibilities presented by Prof. Avellan, and has concluded that the approach to be followed should meet the simplicity and robustness criteria required for industrial applications. The idea put forward by this project is a novel one, with potential for tackling the severe unsteadiness in hydraulic turbines operated at part discharge.

Following this meeting, a research agreement has been drafted, in order to start the projet on Jan 1st, 2006.

It has been agreed that the FLINDT Francis turbine geometry will be used for the investigations within this project, provided that a non-disclosure agreement is signed between EPFL and UPT.

2.1. Meeting at the Rector's Office at the "Politehnica" University of Timișoara

Tuesday, Nov. 01, 2005, 10:00 a.m.

Participants: **Prof. François Avellan**, Ecole polytechnique fédérale de Lausanne, Deputy Dean of the School of Engineering, Director of the EPFL Laboratory for Hydraulic Machines, **Prof. Nicolae Robu**, Rector UPT, **Prof. Viorel Aurel Șerban**, Vice-Rector UPT, **Prof. Romeo Susan-Resiga**, Head of the National Center for Engineering of Systems with Complex Fluids, **Prof. Liviu Eugen Anton**, Hydraulic Machinery Dpt., **Mrs. Diana Oltean**, on behalf of the International Relations Dpt.

Issues discussed:

- Evaluation of the activities within the "Agreement of Academic and Scientific Cooperation between Ecole polytechnique fédérale de Lausanne and Politehnica

University of Timișoara". Prof. Resiga briefly presents the activities since 2002 when the agreement was started. A new joint research project, funded by the Swiss NSF will be started in Jan. 2006, for duration of 36 months, with a research team from both EPFL-LMH and UPT-NCESCF. Two students from UPT will complete their dissertations at EPFL-LMH in 2006.

- Prof. Avellan, Chairman of the Hydraulic Machinery and Systems Section of the International Association for Hydraulic Research, invited UPT to host a future venue of the IAHR Symposium on Hydraulic Machinery and Systems. This prestigious scientific forum brings together all leading specialists in hydraulic machines and equipments from both academia and industry. As a member of the executive committee of IAHR-Hydraulic Machines section, Prof. Resiga will be in charge with the local organising committee. Prof. Robu offers the institutional support for this initiative.
- Both parties agreed that there are many common interests between the two universities. It is beneficial for UPT to see how other universities are operating in general. Prof. Avellan is presenting the EPFL strategy of organizing a "matrix" to interlink the educational and research activities. Prof. Robu agrees with this structure, and briefly presents the ideas along these lines that are currently implemented at UPT.
- Prof. Avellan emphasized the importance of selecting the field of study when students are entering the university. Also, the renewal of the teaching staff is very important because new generations are coming. Prof. Avellan shows that at EPFL approx. 30% of the student body are foreign students. He offers several suggestions on how UPT can attract foreign students, mainly for Master and PhD programmes.
- Prof. Robu and Prof. Șerban are introducing the "Politehnica International" initiative at EPFL. The difficulties associated with teaching small groups of students for each specialization are examined and discussed. The value and advantages of the student exchange programmes are discussed.
- The UPT has one important advantage of having a large student campus, with good accommodation facilities. Already several German PhD students are enrolled at the UPT.
- The structure of Bachelor-Master-PhD education is discussed, in the framework of the Bologna process.
- Prof. Avellan approaches the idea of inter-university Doctoral Schools, that bring together professors and PhD students in a particular field (e.g. hydraulic machines) from leading universities in Europe. Courses within Doctoral Schools are to be held successively at the universities entering in such initiative. It has been agreed to further explore the possibilities of funding the mobility within Doctoral Schools from specific European programmes.
- In order to evaluate and quantify the activity of the faculty, Prof. Avellan has presented the experience at EPFL with respect to the on-line data base of publications. Such fully searchable data base is set up and developed by a specialized person, and offers quick and accurate reports on publication activity of individual and groups. Moreover, the Master dissertations are posted as abstracts, and the PhD theses are fully available on electronic format. Prof. Robu agreed that such a structure should be implemented at the UPT. Prof. Avellan suggests that the person (or persons) in charge can be from the UPT central library.

- Both parts have agreed that a framework for regular bi-lateral meetings should be established, at both executive and experts levels.

2.2. Meeting with the faculty from Mechanical Engineering School

Wednesday, Nov. 02, 2005, 12:00 a.m.

Participants: **Prof. François Avellan**, Ecole polytechnique fédérale de Lausanne, Deputy Dean of the School of Engineering, Director of the EPFL Laboratory for Hydraulic Machines, **Prof. Nicolae Neguț**, Dean of the Mechanical Engineering School, **Prof. Romeo Susan-Resiga**, Head of the National Center for Engineering of Systems with Complex Fluids, faculty members from the Mechanical Engineering School.

Issues discussed:

- Financial resources distribution for engineering education.
- Number of specializations in engineering, and mechanical engineering in particular, at EPFL and UPT, respectively.
- Activity evaluation for faculty; group evaluation versus individual evaluation.
- Implementation of the Bologna process; 3+2 versus 4+1 approach for Bachelor+Master education.

2.3. Meeting with candidate students for EPFL-UPT student exchange program

Wednesday, Nov. 02, 2005, 03:00 p.m.

Participants: **Prof. François Avellan**, Ecole polytechnique fédérale de Lausanne, Deputy Dean of the School of Engineering, Director of the EPFL Laboratory for Hydraulic Machines, **Prof. Romeo Susan-Resiga**, Head of the National Center for Engineering of Systems with Complex Fluids, **Cătălin Stroiță** and **Irina Moisă**, students in Mechanical Engineering – Hydraulic Machines specialization.

Prof. Avellan was interviewing the two candidate students, and has specified the dissertations themes:

1. Analytical and numerical investigation of turbomachinery swirling flows stability
2. Numerical simulation and analysis of three-dimensional unsteady cavitating vortex rope in hydraulic machines.

It has been specified a set of topics for students to study prior to the research period at EPFL. These topics include rotating axi-symmetric flows, Rayleigh-Plesset equation for a 2D bubble. Also, the students will improve their verbal/written communication skills.