



Joint IAS/PELS/IES German Chapter meets at EPFL, Lausanne, Switzerland

By Dr. Ingo Hahn

The international chapter meeting took place in conjunction with a workshop and a seminar program at Ecole Polytechnique Fédérale de Lausanne, i. e. Swiss French speaking technical university on June 2-3, 2005. Many international guests attended the workshop and technical seminar on June 2nd, 2005.

Mr. Christoph Weissbacher presented the actual research results of the German FH Köln/RWTH Aachen team participating in the IEEE Future Energy Challenge 2005 contest. The FH Köln/RWTH Aachen team simulated a single phase inverter to be used in photovoltaic applications of 1 kW, for both 220 Volt / 50 Hz and 110 Volt / 60 Hz in both stand-alone and grid operation. The objective of the work was to find control parameters for voltage (stand-alone) and current (grid) control and to verify them with the PSIM simulation environment.

In the sequel Mr. Olivier Toury gave a lecture about PSIM virtual machinery of a cruise ship for dynamic performance studies. The lecture presented the design and the results of a virtual machinery tool developed with PSIM software dedicated to transient analysis of All Electric Ship power networks.

Dr. K. S. Rajashekara of Delphi Corporation followed with a guest lecture about hybrid fuel cells for transportation and stationary power generation. A hybrid power system consists of a combination of two or more

power generation technologies to best make use of their operating characteristics and to obtain efficiencies higher than that could be obtained from a single power source. Since fuel cells directly convert fuel and an oxidant into electricity through an electrochemical process, they produce very low emissions and have higher operating efficiencies. Hence combining fuel cells with other sources, the efficiency of the combined system can be further increased or extend the duration of the available power to the load as a back-up power. Different types of fuel cell hybrid systems for the mentioned applications have been presented.

The next highlight was the distinguished lecture of Prof. Deepak Divan of Georgia Tech about the opportunities and market needs for power electronics and power systems. The transmission and distribution infrastructure is aging and congested, and in urgent need of modernization. Power electronics may offer a new approach for relieving fundamental bottlenecks that have distorted the electricity market and have degraded system reliability. A new category of solutions, Distributed FACTS or D-FATS, have been presented as a potentially cost-effective alternative for controlling power flow on the grid, improving system reliability and utilization of existing assets.

The social meeting took place at the restaurant de Dorigny of EPFL with a view

on the beautiful scenery of lake Lemman up to Mont Blanc massif. Local organizer Prof. Rufer of EPFL opened the banquet. Interesting discussions about technical and other issues developed. Society presidents of IAS (Landis Floyd), PELS (Rik De Doncker), IES (Charles Einolf) and also past IAS 2000 president (Caio A. Ferreira) were present at the banquet. The organisers' gratitude for support of the meeting was expressed during an awards ceremony.

About 60 participants listened to the different lectures at EPFL on June 3rd, 2005. First Prof. Paul Sunderland gave an overview about the school of engineering of the EPFL, consisting of 4 sections with 8 different institutes, headed by 62 professors out of 200 in total. The school of engineering has an annual budget of about 90 million US\$. Research topics besides are reflected in different trans-disciplinary centers, namely space, brain & mind, Bernoulli, biological engineering and energy. According to the Bologna declaration the curriculum is divided in a 3 year bachelor and a 5 year master program in engineering. EPFL in sum has 6400 students (2004) and 3120 employees. Faculty members come up to 50% from Switzerland, up to 25% from USA and up to 20% from all over Europe, where it has been ranked within the top 10 universities.

The second lecture given by Dr. Francois Marechal introduced the institute of energy



Small talk in front of the awards. Left to Right, Prof. Alfred Rufer (EPFL), Dr. Peter Magyar (IAS Region 8 chapter area chair/West).



Discussion on special topics during the social meeting. Left to Right, Prof. Carlo A. Nucci (Univ. Bologna), Dr. Charles Einolf (IES President-elect), Prof. Rik De Doncker (PEL's President), Dr. Andreas Luxa (German PES Chapter Chair), Prof. Anthony C. Davies (past Region 8 director).

sciences. Dr. Marechal explained the different research topics, being related to each other, i. e. systems analysis, electromagnetics, fluid mechanics, heat and mass transfer and thermodynamics.

In the following Prof. Jean-Jacques Simond, head of the laboratory for electrical machines, presented insights about the modern design of high power generators. His special approach to solve the design of a 6-phase synchronous machine for a 20 MW gas compressor turbine is a machine with solid iron rotor with excitation and damper windings. Within the stator a

double winding scheme is used, where the first three phases are translated against the second three phases by an angle of 30° to eliminate the 5th and 7th harmonics of the flux linkage. With this translated double stator structure it is possible to suppress the 6th harmonic of the produced torque. Prof. Simond presented a numerical test platform for the developed turbo generators, parameterized by mechanical dimensions of the iron and copper parts of the respective electrical machine; the user can calculate different operational modes.

The next lecture (was) given by General Chairman and host Prof. Alfred Rufer described an example of multi-disciplinary

research in the field of a hybrid energy storage system. His approach uses compressed air and super-capacitors. Prof. Rufer explained the thermodynamics of pneumatic energy storage with some examples for the adiabatic, the isochoric and the isobaric state transitions needed to understand the hybrid energy storage system, and presented a novel UPS with compressed air and super-capacitors which uses a maximum efficiency point tracking control. The efficiency of the pneumatic motor is less than 20%, leading to the suggestion to replace it by a hydraulic motor. This system and further setups for research and education - such as a model railway or an electric scooter - have been demonstrated during a subsequent lab tour.

In the following Dr. Eric Carroll of ABB Switzerland gave an overview about high power semiconductor development and manufacturing. After a comparison of the safe operating areas (SOA) of IGBTs and IGCTs insights in the most advanced development of high SOA IGBTs with special switching self-clamping mode (SSCM) have been given. The presentation of the leading Swiss Power Semiconductor company concluded with an introduction to new diode developments, optimizing especially critical snap off behavior.

The digest of Swiss and European High Tech research and development was complimented by the presentation of Prof. Johann Kolar, ETH Zürich. After an introduction to ECPE, the European Center for Power Electronics - aiming at the promotion of research, innovation, education, publicity and technology transfer in the area of power electronics in Europe - he described particular research work carried out in cooperation with ECPE at his Power Electronic Systems Laboratory: This comprised topics like hybrid EMI filtering and matrix converters - especially sparse matrix converters including all-SiC versions to be operated at 150 kHz switching frequency. By successful integration, a power density of 25 kW/l has already been achieved, being a basis to work on the challenging number of 50 kW/l for the future.

An unforgettable highlight of the chapter meeting was the visit of European Research Center CERN in Geneva.

For further information about the IEEE IAS/PELS/IES German Chapter please visit our homepage at <http://www.ewh.ieee.org/r8/germany/ias-pels>

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