

Fill this form and mail, fax, or e-mail a copy before **January 19<sup>th</sup>, 2014** to:

Ms. Mathilde Brocard  
Swiss Federal Institute of Technology (EPFL)  
EPFL STI, GR-SCI-IEL  
ELL 116 (Bâtiment ELL)  
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[ees.uetp@epfl.ch](mailto:ees.uetp@epfl.ch)

**Registration Form**

Firstname : \_\_\_\_\_ Surname : \_\_\_\_\_  
Company : \_\_\_\_\_  
Position : \_\_\_\_\_  
Address : \_\_\_\_\_  
Phone : \_\_\_\_\_ Fax : \_\_\_\_\_  
E-mail : \_\_\_\_\_  
Company main activity : \_\_\_\_\_

**COURSE FEES**

The course fees include lectures, documentation, coffee breaks and lunches

Members of the EES-UETP: 367.5 EUR  
University non members of the EES-UETP: 900 EUR  
Industry non members of the EES-UETP: 1500 EUR

The Course Secretariat will send an invoice to each registered participant, after the reception of the filled Registration Form.

**ACCOMMODATION**

Special Prices have been arranged. Please contact directly the hotel:

**Ibis Lausanne Centre**

Rue du Maupas 20, CH-1004 Lausanne, Switzerland  
Phone : +41- 21 340 07 07, Fax : +41- 21 340 07 17  
[h6772@accor.com](mailto:h6772@accor.com); [www.ibishotel.com](http://www.ibishotel.com)

or,

**Starling Hotel Lausanne**

Route Cantonale 31, 1025 St-Sulpice, Switzerland  
Phone : +41 21 694 85 85, Fax: + 41 21 694 85 86  
[contac@shlausanne.ch](mailto:contac@shlausanne.ch), [www.shlausanne.ch](http://www.shlausanne.ch)

The price for a single-room with breakfast ranges from 100 to 200 CHF. Taxes are included.

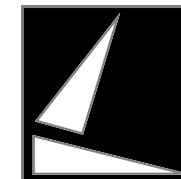
Room reservations must be made by **January 12<sup>th</sup>, 2014**. Please mention “**EES-UETP**”. Reservation requests after that date will be based on space and rate availability.

**INFORMATION, REGISTRATION AND COURSE LOCATION**

Swiss Federal Institute of Technology (EPFL)  
CH-1015 Lausanne, Switzerland  
[www.epfl.ch](http://www.epfl.ch)

Secretariat : [ees.uetp@epfl.ch](mailto:ees.uetp@epfl.ch)  
Phone: +41-21-693 11 55, Fax: +41-21-693 46 62

Course Coordinator : [rachid.cherkaoui@epfl.ch](mailto:rachid.cherkaoui@epfl.ch)  
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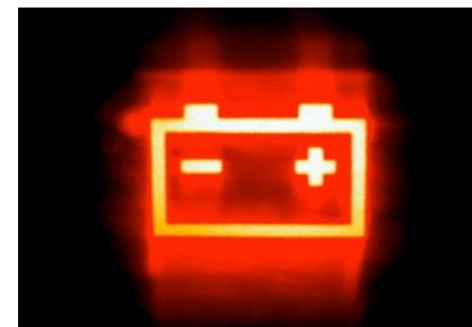


**Electric Energy Systems**  
**University Enterprise Training Partnership**  
<http://www.ees-uetp.com/>

**2014 Course Program**

**Energy Storage in Power Systems: Technologies, Applications and Future needs**

**February 4<sup>th</sup> (2:00 pm) to 7<sup>th</sup> (1:00 pm), 2014**



**Organized by**  
**Swiss Federal Institute of Technology**  
**EPF-Lausanne and ETH-Zürich**

**Switzerland**

**Sponsored by**  
ENEL – EDF – IBERDROLA – RTE

## OBJECTIVES

The increase of the penetration of renewable energy resources (RERs) into electrical networks is certainly related to the availability of energy storage systems (ESSs). Indeed, the use of ESSs could, in principle, provide several ancillary services to electrical grids such as: balance of RERs energy production, balance local loads, reserves provision, islanded operation of distribution systems, integration into low voltage microgrids, etc.

The above-mentioned services are characterized by different energy and power requirements that involve the use of appropriate storage technologies. In this respect, the course aims at providing the state-of-the-art of ESSs technologies, their modeling as well as their applications into electrical grids both in large and small scales.

## INTENDED AUDIENCE

This course is intended for professionals from transmission/distribution system operators, regulators, generation companies, customers (industrial facilities), consultants and post-graduate students.

## COURSE DURATION

Three days, from Tuesday the 4<sup>th</sup> (2 pm) to Friday the 7<sup>th</sup> (1:00 pm) of February, 2014.

## CONTENTS

1. **The need of balancing power with storage** (G. Andersson)
2. **Technologies:**
  - a. Modern Compound and Reversible Units for Pumped Storage Power Plants (F. Avellan)
  - b. Battery energy storage systems (C. A. Nucci)
  - c. Hydrogen: production, storage, applications and safety (A. Zuettel)

- d. Energy storage systems properties - case of Compressed Air Energy, Vanadium Redox flow Battery, Supercaps, etc. (A. Rufer)
- e. Electro-thermal electricity storage systems: (F. Marechal)

### 3. Applications

- a. Large systems applications
  - i. Large pumped storage hydro power plants (T. Aschwanden)
  - ii. Storage vs. Demand side management: issues and opportunities from TSO perspectives (W. Sattinger)
  - iii. Applications of BESS in electric power systems with renewable generation (A. Oudalov)
  - iv. Grid operation & flexibility with Energy Storage and demand response- Implementation and Economics (T. Borsche / A. Ulbig)
  - v. Requirements and possibilities for energy storage applications in railway power supply (M. Aeberhard / N. Cherix)
- b. Distribution systems applications
  - i. Distribution networks support (voltage control, islanding) (A. Borghetti)
  - ii. Controlling and managing V2G and V2H (J. Peças Lopes)
  - iii. Seal-healing operation of microgrids with BESS (M. Paolone)

## INSTRUCTORS

**Göran Andersson**, ETH-Zurich, Switzerland.  
**François Avellan**, EPF-Lausanne, Switzerland.  
**Carlo Alberto Nucci**, University of Bologna, Italy.  
**Andreas Züttel**, EMPA, Switzerland.  
**Alfred Rufer**, EPF-Lausanne, Switzerland.  
**François Marechal**, EPF-Lausanne, Switzerland.  
**Thomas Aschwanden**, Kraftwerke Oberhasli AG, Switzerland.  
**Walter Sattinger**, Swissgrid, Switzerland.  
**Alexandre Oudalov**, ABB Corporate Research, Switzerland.  
**Theodor Borsche**, ETH-Zurich, Switzerland.  
**Andreas Ulbig**, ETH-Zurich, Switzerland.  
**Martin Aeberhard**, SBB-CFF, Switzerland.  
**Nicolas Cherix**, EPF-Lausanne, Switzerland  
**Alberto Borghetti**, University of Bologna, Italy.  
**Joao Peças Lopes**, INESC, Portugal.  
**Mario Paolone**, EPF-Lausanne, Switzerland

## COURSE COORDINATORS

### Göran Andersson

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Power systems laboratory  
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### Mario Paolone

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Swiss federal Institute of Technology (EPF-Lausanne)  
(course location)

**The number of attendees  
is limited.**