

## Fees

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

## Registration

For registration, please send the following information:  
name; company; position; address; phone and fax; e-mail;  
company main activity

to Laura Val

[lval@irec.cat](mailto:lval@irec.cat)

## Information and location



Jardins de les Dones de Negre 1, 2<sup>nd</sup> floor  
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# Workshop on “HVDC grids for offshore wind power”

December 10<sup>th</sup> - 12<sup>th</sup> 2012

Catalonia Institute for Energy Research (IREC),  
Barcelona, Spain



## EES-UETP

Electric Energy Systems  
University Enterprise Training Partnership

With the participation of:



## Objectives

The workshop is intended to introduce the technologies available and the ongoing research in the field of HVDC transmission systems for offshore wind power plants. Both the technologies related to wind power plants and HVDC are covered.

The workshop will concentrate on some relevant aspects as the control and operation, modeling and simulation, design and planning, protection and interaction with the grid. Commissioned, ongoing and future projects will be also presented. The workshop has been designed to present the mentioned technologies and at the same time introduce the numerous challenges which are to be solved related to the development of HVDC grids for offshore wind power.

## Coordination

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Dr Dirk Van Hertem (KU Leuven)  
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## Instructors

Dr Pär Samuelsson (ABB)  
Rafael Bonchang (Alstom Grid)  
Marcia Martins (Alstom Wind)  
Johan Rimez (Elia)  
Dr Alexandre Parisot (RTE France)  
Dr Jun Liang (Cardiff University)  
Dr Dirk van Hertem (KU Leuven)  
Jef Beerten (KU Leuven)  
Hakan Ergun (KU Leuven)  
Dr Helder Leite (Porto University)  
Dr Oriol Gomis-Bellmunt (CITCEA-UPC, IREC)  
Agustí Egea (CITCEA-UPC)  
Dr Adrià Junyent (CITCEA-UPC)

## Workshop Contents

### •Day 1 (Dec 10<sup>th</sup> 2012)

#### Context

(1.5 h) *Dirk Van Hertem (KU Leuven)*

Why HVDC? Why VSC?

Introduction to HVDC grids

Requirements and obstacles for HVDC grids for offshore wind

Economic issues

#### MMC VSC HVDC technology

(1.5 h) *Rafael Bonchang (Alstom Grid)*

VSC-HVDC converter technologies

HVDC cables

HVDC substations

Cost analysis

#### VSC-HVDC offshore wind power connections

(1.5 h) *Pär Samuelsson (ABB)*

Converter structure and substation.

Control and operation of MMC converters: active reactive power/DC-voltage/PWM/Fault ride through

Point-to-point VSC-HVDC links

Offshore wind power connections

Examples of ongoing projects: Borwin1, Dolwin1 & 2

#### Offshore wind turbines and wind power plants technology

(1.5 h) *M. Martins (Alstom Wind)*

Technology overview

Offshore wind turbine concepts

AC and DC offshore wind farms

Wind power plants operation and control

Offshore wind technology

Offshore wind turbine technology

Offshore wind power plant technology

### •Day 2 (Dec 11<sup>th</sup> 2012)

#### Operation and control of HVDC grids for offshore wind

(1.5 h) *O. Gomis (CITCEA-UPC, IREC) and A. Junyent (CITCEA-UPC)*

Operation of HVDC systems for offshore wind

Voltage control schemes

Normal operation

Fault operation

Voltage control for multi-terminal VSC-HVDC grids

Droop control for the grid-side VSC-HVDC converters

Droop control for the wind power plant VSC-HVDC converters

Droop control constants design procedure

#### Modeling and simulation of HVDC grids for offshore wind

(1.5 h) *J. Liang (Cardiff University) and A. Egea (CITCEA-UPC)*

Modeling of the components

Simulation case studies

Experiences with RTDS and scaled laboratory test benches

#### Analysis and design of HVDC grids for offshore wind

(3 h) *Jef Beerten (KU Leuven), J. Rimez (Elia) and Hakan Ergun (KU Leuven)*

Power flow analysis of HVDC grids

Secure operation of power systems with HVDC and HVDC grids

Design and planning of HVDC grids

Offshore grid planning of the Belgian TSO Elia

### •Day 3 (Dec 12<sup>th</sup> 2012)

#### Protection issues

(2 h) *Helder Leite (Porto University)*

VSC-HVDC System Protection: review of current methods

Challenges of protection of a VSC-Multi-Terminal HVDC

The influence of a VSC-based HVDC Link on the AC network short circuit ratio

AC grid protection for grids with VSC-HVDC converters

#### Interaction with the AC grid

(2 h) *Jun Liang (Cardiff University)*

AC grid support

Simulated case studies

#### HVDC Supergrid from the TSO perspective

(2 h) *Alexandre Parisot (RTE France)*