

# The European Power Electronics Association



Conservatoire national des arts et métiers **le cnam**  
Groupe de Travail Réseaux et Systèmes Électriques Intelligents

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Invite you to attend the next EPE Control Chapter Symposium on Smart  
Grids (EPE-CCS)

**DC grid for more Renewable Energy Penetration  
in the Power Networks of the Future  
DC grid control and operations**

**January, 24th, 2013**

Conservatoire national des arts et métiers (Cnam)

2, rue Conté, 75003 Paris, France

Amphithéâtre **Gaston-Planté**, accès **35** - Étage **1**



Réseau de transport d'électricité



# **DC grid for more Renewable Energy Penetration in the Power Networks of the Future**

## **DC grid control and operations**

Nowadays, more than ever, the power engineering domain is facing enormous challenges since the increasing interest in intermittent renewable energies, which impose a completely new operation paradigm. The use of these resources must be done in ways that guarantee a secure, autonomous, sustainable, clean and competitive operation. A realistic solution to enhance the share of renewable sources could be wind power generation, which has prompted different countries to install wind turbines offshore. In Europe, the offshore wind potential is able to cover seven times its whole demand. This push towards offshore has raised even more challenges. HVAC provides the simplest and most economic connection method for short distances, but since the distance of the offshore farms exceed 50-80km, the transmission with High Voltage Direct Current (HVDC) based on either the conventional current source converter (CSC-HVDC) or the voltage source converter (VSC-HVDC) is unavoidable. The CSC technology characteristics make the multi-terminal (more than three converters involved) operation unfeasible. It has been shown that the VSC structure presents several advantages and is better fit than CSC systems in terms of independent, fast and flexible active and reactive power control. In fact, to reverse power direction in a CSC system is complex and needs a mechanical procedure. On the contrary, the VSC converter behaves as a synchronous generator which solves the problem of power flow reversibility. In addition, the recent advances in power technologies open the door for VSC HVDC to a higher power range, which makes the multi-terminal HVDC (MTDC) system a technical possibility. In addition, the emergence of a wider range of power electronic devices is contributing to revitalize the research on DC transmission networks, where DC/DC converters will play a decisive role. These DC/DC transformers have to be bidirectional (must be able to transfer energy in one direction or another by just making a change in the direction of current), and thus being able to control the power flow between a network and another. The MTDC grid will interconnect remotely located offshore wind farms and connect them in various points to the existing AC infrastructure, to provide a more reliable grid. This enables the opportunity to building a whole overlaying DC SuperGrid, which could have a number of economical and technical advantages over AC transmission. The symposium objective is to provide sufficient clarifications with adapted tools on how to control and handle such complex system in “plug and play” manner.

**For registration (Free of charge), please send the following information:**

Name, company, email

To **Miguel Jimenez**: Miguel.Jimenez@lss.supelec.fr

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## Symposium Program

08:00 **Registration and refreshments**

08:50 **Chairs welcome and opening**

Jean-Luc THOMAS – Cnam, EPE president

### Session 1: Power network of the future

09:00 **AC/DC power systems: DC grid, an additional degree of freedom for power network control and stability**

Abdelkrim BENCHAIIB, Alstom Grid, Chairman of EPE Control Chapter

09:20 **France – Spain, SuperGrid First Module?**

Marie-Sophie DEBRY, RTE

### Session 2: Winpower project: Integration of wind energy via DC grid

#### Part 1: High level operation and control

09:40 **DC grid for wind integration : Overview of the Winpower project**

Gilney DAMM, Université d'Evry

10:00 **Economic model for DC Grids**

David MERCIER, CEA

10:20 **Wind energy prediction**

Robin GIRARD, MINES ParisTech

10:40 **Operation of wind production and storage virtual power plants by multi-agent systems**

Javier GIL-QUIJANO, CEA

11:00 **Refreshments**

### Session 3: Winpower project: Integration of wind energy via DC grid

#### Part 2: Low level control

11:30 **Optimal power flow operation of multi-terminal HVDC with energy storage**

Fernando DORADO NAVAS, Universidad de Sevilla

11:50 **Voltage control of a HVDC network with variable generation**

Marc PETIT, Supelec

12:10 **Stability analysis of a control strategy for a multi-terminal VSC-HVDC system**

Yijing CHEN, L2S, Université de Paris sud

12:30 **Frequency control coordination among non-synchronous AC areas connected by a multi-terminal HVDC grid**

Jing DAI, Supelec

12:50 **Lunch**

**Session 4: Other systems impacting DC and AC power networks**

- 14:00 **DC/DC Transformers: modeling and control**  
Miguel JIMENEZ CARRIZOSA, Supelec
- 14:20 **Distributed energy storage, towards smart grid**  
Guillermo GARCIA-SOTO, Alstom Grid
- 14:40 **Influence of superconductor components on network stability**  
Lazhar, KEBBABI, Nexans
- 15:00 **Modern pump storage power stations using variable speed technology**  
Alexander SCHWERY, Alstom Power - Hydro
- 15:20 **Refreshments**

**Session 5: DC grid within smart grid issues**

- 16:00 **Round table : Economical perspectives of DC networks and of HVDC/  
MVDC control and operations - Introduction to the round Table**  
Pierre OLLIVIER, Winnove
- 17:00 **Chairs closing**  
Jean-Luc THOMAS – Cnam, EPE president
- 17:10 **Close of symposium**