1.1 NEW HVDC PROJECTS IMPLEMENTATION

**Wednesday 27th May**  (13.00 - 14.45)

111 Skagerrak - The Next Generation  
M. Hyttinen, G. Andersson

112 Labrador Island Link ±350kV HVDC Transmission Scheme - Key Design Aspects  
S. Manshi, A. Kumar, S Chakravorthy, R. Suri, R.A. Makhedkar, J. Coudy

113 Control and Protection Design Aspects for Parallel Converter Operation of ± 800 kV, 6000 MW Champa - Kurukshetra HVDC Link  
V. Singh, M.S. Rao, S. Bhattacharya, M.M. Goswami, O. Chandy

114 Protection Strategy for HVDC Systems With Dedicated Metallic Return (DMR) Conductors  
V. Pathirana, U. Gnanarathna, O.M.K.K. Nanayakkara

1.2 OPERATING EXPERIENCE OF VSC HVDC

**Wednesday 27th May**  (15.15 - 17.00)

121 Delivery of the Nan’ao Multi-terminal VSC-HVDC System  
G. Bathurst, P. Bordignon

122 PJM Planning Study Practices and Market Impacts on the Integration of Renewable Resources With AC-HVDC Systems  
J. Tong, M. Sobotka, W. Qiu, B. Choi, A. Keech

123 CANCELLED - FACTS and HVDC Technologies for the Development and Enhancement of Spanish Transmission Grid

124 Study on Discharge Characteristics of DC System in Zhoushan Multi-Terminal VSC-HVDC Transmission Project  
X. Li, Y. Ma, B. Yue, W. Ma, D. Chen

125 Recent Advancements in HVDC VSC Systems  
P. Lundberg, A. Gustafsson, M. Jeroense

1.3 DEVELOPMENTS IN DC CIRCUIT BREAKERS

**Thursday 28th May**  (08.30 - 10.15)

131 Demonstration of 30kW IGBT LCL DC/DC converter as proof of concept for interconnecting HVDC systems into a future DC grid  
S.M. Fazeli, M. Hajian, D. Jovcic

132 The Commutation Booster, a New Concept to Aid Commutation in Hybrid DC-Breakers  
J. Magnusson, R. Saers, L. Liljestrand

133 Optimisation of Passive System Components to Minimise DC Circuit Breaker Stresses in Multi-Terminal Systems  

134 A Lightweight DC Collection and HVDC Transmission System Equipped with DC-DC Converter for Offshore Wind Farms  
K. Sano, N. Gibo

135 DC Circuit Breakers for HVDC Grid Applications  

1.4 CONTROL and PROTECTION OF DC GRIDS

**Thursday 28th May**  (10.45 - 12.30)

141 CANCELLED - Anti-Windup PI Control of the VSC-based HVDC Converter

142 Control System Interaction in the VSC-HVDC Grid Connected Offshore Wind Power Plant  
J. Glasdam, L.H. Kociewiak, J. Hjerrild, C. L. Bak

143 Classification of Fault Clearing Strategies for HVDC Grids  
W. Leterme, D. Van Hertem

144 Protection scheme for multi-terminal radial VSC HVDC system without communication between terminals  
J.I. Marvik, S. D’Arco, K. Sharifabadi

145 Calculation of Short-Circuit Currents in Multi-Terminal HVDC Systems based on Modular Multilevel Converters  
A. Wasserrab, G. Balzer

1.5 ROAD MAP and VISION FOR DC GRIDS

**Thursday 28th May**  (13.30 - 15.15)

151 A Technological Roadmap for the Development of the European Supergrid  
N. Macleod, M. Callavik, M. Boden, M. Dhesi, R. Huuva, N. Kuljaca, F. Schettler

152 The Role of Embedded VSC-HVDC in the European Power System  
A. L’Abbate, R. Calisti, F. Careri, S. Rossi

153 Impacts of VSC-HVDC on AC Grid Performance  
E. Muyembe

154 A Systematic Study on Fault Currents in Multiterminal HVDC Grids  
M. Heidemann, D. Eichhoff, C. Petino, M. Stumpe, E. Spahic, F. Schettler

155 Fast Reduction of DC Voltage for Half-Bridge MMC HVDC Systems with Symmetrical Monopole during the Non-permanent Pole to Earth DC Fault  
M. Salimi, X. Chen, D. Woodford, A. Gole

1.6 POWER ELECTRONIC DEVICES and CONVERTER

**Thursday 28th May**  (15.45 - 17.30)

161 Power Semiconductors for Voltage Source Converters in HVDC and STATCOM Applications  
M.J. Heuvelmans, T. Modeer, S. Norrga, H-P. Nee, T. Jonsson

162 A Simplified Second-Order Model of a VSC-HVDC Link for Dynamic Studies  
M. Imhof, E. Igglund, G. Andersson
2.1. HVDC PLANNING

Wednesday 27th May  (13.00 - 14.45)

211 Indicators for the Placement of Embedded HVDC Systems in Interconnected AC Networks
H. Barrios, A. Roehder, H. Nautemeyer, C. Cieslak

212 Aspects of HVDC Systems in the Nordic Region
J. Lamponen, L. Hauria, R. Hirvonen

213 The Need for HVDC Systems in South Africa and the Region
R. Marais, K. Leask

214 Long-term Planning of the European Power System Considering Different HVDC Installation Costs
P. Wiernes, A. Moser

215 Upgrading Existing LCC HVDC Schemes With VSC Technology
R. Valiquette, V. Pathirana

2.2. GENERAL SYSTEM PLANNING

Wednesday 27th May  (15.15 - 17.00)

221 Receiving-end Power Network Expansion Planning Considering Large-scale Wind Power Bases Integration With HVDC Lines
Y. Guo, J. Li

CANCELLLED - A Technical & Economical Study on the Alternative Ways to Solve the Fault Current Problem in Seoul Metropolitan Area

223 Planning the Optimal Number and Placement of Embedded VSC-HVDC Links in the German AC Transmission Grid
H. Pluntke, W.H. Wellassow

224 Transmission Expansion Planning Challenges Associated to Belo Monte Power Plant’s HVDC Link
M.V.G. da S. Farinha, M. de Fátima de Carvalho Gama, T. de Faria Rocha Dourado Martins

225 Assessment of the Impact on Direct Current and Alternating Current Systems Following a Change of the Bulk Power System
K. Takada, A. Matsuda, N. Fujikata

2.3 MARKET RELATED SYSTEM PLANNING

OTHER SYSTEM ISSUES

Thursday 28th May  (08.30 - 10.15)

231 Increasing Hosting Capacity through Dynamic Line Rating – Risk Aspects
N. Etherden, M. Bollen, T. Tjäder

232 Comparison of VTL calculations using Linear and Non-linear method
R. Ramanathan, A. Popat, B. Tuck

233 Boosting the Grids Integration Through the Evolution of the Ancillary Service Market Framework for a Smarter Management of VRE
E. Elia, P. Portoghese, G. Sommantico, B. Cova, A. Venturini, P. Vicin

2.4 ON-LINE MONITORING AND MEASUREMENT

METHODS FOR ASSESSING SYSTEM PERFORMANCE

Thursday 28th May  (10.45 - 12.30)

241 Experience with Using PMU Data for Online Monitoring of Sub-synchronous Resonance
S. Bengtsson, S. Holmström, M. Chenine, M. Jarl

242 Real-time Testing of Dynamic Security Assessment Algorithms
J. Greganage, U.D. Annakkage, T. Weekes, B.A. Archer, H. Meiklejohn

243 A Simulation Based Study on the Effect of Data Dropout on the Performance of Synchrophasor Based Power System Stabilizers
A.I. Komara, U.D. Annakkage

244 An Oscillation Monitoring Algorithm to Monitor Power System Oscillations using Synchronized Phasor Measurements
D.P. Wadduwage, U.D. Annakkage, K. Narendra

245 Investigating Distance Relay Behaviour on an EHV AC Lines Connected With Voltage Source Converter Based HVDC
M. M. Alam, H. Leite, A.S. Carvalho

2.5 HARMONIC, POWER QUALITY and EMC ISSUES

RELATED TO HVDC and CONVERTER BASED TECHNOLOGIES

Thursday 28th May  (13.30 - 15.15)

251 Using Transfer Impedances to study Harmonic Resonances due to AC Cables in a Transmission System
M. Bollen, S. Ackebly, H. Jansson, M. Jonsson

M. Bollen, S. Rönberg, S. Djokic, F. Zavoda

253 Potential Electromagnetic Interference Between Long Wave Radio Services and Overhead Transmission Lines Caused by Operation of HVDC VSC - a First Estimation
K. Hermann, G. Grieppentrog

254 A study on Electric and Magnetic field effects between EHV AC and DC Lines and its impact on substation equipment
D. Maherswaran, G. Somasundram

255 Measurement of Transient Voltages in a Substation
J. Plesch, E. Sperling, G. Achleitner, S. Pack

2.6 MODELING and DYNAMIC PERFORMANCE

ASPECTS OF INTEGRATING HVDC INTO THE AC POWER SYSTEM

Thursday 28th May  (15.45 - 17.30)

261 CANCELLED - Doubly-fed Induction Generator Wind Power Plant with VSC-HVDC Grid Connection Start-up Procedure


263 Analysis of the AC Polish Power System Impact on the HVDC SwePol Link Operation
M. Przygrodzki, P. Rzepka, M. SZABLICKI, W. Lubicki

264 Fault Clearing Strategies in a Multi-terminal HVDC Grid With Integrated DC Circuit Breaker Device
S. Wenig, R. Sand, A. Frank, M. Sariyeh, T. Leibfried
**3.1 MARKET-BASED SOLUTION METHODOLOGIES**  
*Wednesday 27th May  (13.00 - 14.45)*

- Capacity Remuneration Mechanisms – Implementations in Europe and Implications for the European Internal Energy Market  
  H. Höschle
- Optimal Dynamic Capacity Allocation of HVDC Interconnections for Cross-border Exchange of Balancing Services in Presence of Uncertainty  
  S. Delikaraoglou, P. Pinson, R. Eriksson, T. Weckesser
- CANCELLED - mathematical Frameworks for Horizontal and Vertical Coordination of Transmission Investment Policies
- Network Operation Hierarchies in a Transcontinental Electricity System  
  G. Hawker, K. Bell

**3.2 MARKET EXPERIENCES**  
*Wednesday 27th May  (15.15 - 17.00)*

- Market Integration of an HVDC Interconnection Between France and Spain  
  J. Gaudin, G. Siles Molina
- Market Price Signals and Regulated Frameworks for Coordination of Transmission Investments  
  F. Reguárez, M.R. Hesamzadeh, A. Di Caprio, A. Balkwill, F.-P. Hansen, J. Riesz
- India-Bangladesh Cross Border Exchanges Through High Voltage Direct Current (HVDC) Back-to-back Station - A Success Story  
- Electricity Market Challenges Under HVDC Multi Bipoles and Multi Vendors Environment - Experience Observations in Brazil  
  M. Scechtman, D.O. C. Brasil
- Developing and Integrating Africa’s Regional Electricity Systems and Markets Using VSC-HVDC  
  L.E. Jones, N.M. Kirby

**3.3 PROTECTION and CONTROL OF HVDC and HYBRID NETWORKS FROM A SYSTEM OPERATIONAL PERSPECTIVE**  
*Thursday 28th May  (08.30 - 10.15)*

- Multi-Terminal DC System Line Protection Requirement and High Speed Protection Solutions  
  J. Wang, B. Berggren, K. Linden, J. Pan, R. Nuqui
- System Protection During Contact Faults in Hybrid AC/DC Transmission Systems  
  C. Petino, D. Eichhoff, P. Tunnerhoff, A. Schnettler
- Communication-free Control Solutions for Grid Code Compatibility of HVDC Grids with Offshore Wind Farms  
  C.L. Moreira, B. Silva
- Investigation of the Influence of embedded VSC-HVDC Transmission on Power System Stability  
  P. Chodura, R. De Graaff, M. Gibescu, W.L. Kling

**3.4 SYSTEM OPERATION WITH HVDC EMBEDDED IN AC NETWORKS**  
*Thursday 28th May  (10.45 - 12.30)*

- Developing a concept for coordinated operation of embedded HVDC with regard to active power – What is important to System Operators?  
  D. Andreas, T. Ringelband, J. Schäfer, M. Thiele
- Optimal Operation Strategy for VSC HVDC Links Within an Interconnected Power System  
  K. Frey, K. Rudion, J. Christian
- Fast Local Converter Set Point Adaptation After AC Grid Disturbances Based on a Priori Optimisation  
  A.-K. Merten, F. Sass, D. Westermann
- Role of Smart Grid Technology and Corrective Control in Enhancing Network Capacity Utilisation in Great Britain With HVDC Links  
  Y. Pipelzadeh, R. Moreno, B. CHAUDHURI, G. STRBAC, T.C. Green
- The France – Spain HVDC Link Project - Operational Challenges  

**3.5 INNOVATIONS IN THE OPERATION OF HVDC and HYBRID INTERCONNECTIONS BETWEEN SYNCHRONOUS AREA**  
*Thursday 28th May  (13.30 - 15.15)*

- Dynamic interactions between asynchronous grids interconnected through an MTDC system  
  A.G. Endegnanew, J. Beerten, K. Ulden
- Hybrid Grid Operation in Indian Power System  
  T. Mutha Kumar, P.R. Koghrum, S.P. Kumar, S.R. Narasimhan
- Development of Imbalance Netting via HVDC Lines between Two Synchronous Areas exemplified by Germany and Nordic  
  M. Maurer, P. Zolotarev
- Monitoring the Performance of the Generating Units Contributing to Frequency and Voltage Control in the Norwegian Power System  
  O. Gjerde, D. Whitey, P. Bertolini
- TSO Pan-European Co-operation and further steps and initiatives to strengthen the Power System Security with ENTSO-E-Wide Awareness System (EAS)  
  C. Norlander, T. Losq, J. Albrecht

**3.6 SYSTEM OPERATION OF MULTI-TERMINAL HVDC**  
*Thursday 28th May  (15.45 - 17.30)*

- HVDC Grid Controller  
  E. Hohenberg, M. Zeller, D. Varma, E. Spahic, F. Schettler
- Distributed voltage control and fault management of star-connected Multi-terminal VSC MMC systems  
  K. Vennemann, D. Meyer, C. Heising, V. Staudt, K. Kleinekorte
- Overview of a Hierarchical Controller Structure for Multi-Terminal HVDC Grids  
  R. Wige, M. Imhof, M. Bacher, G. Andersson
- Disturbance Management in a DC Grid Using a Hierarchical Control Structure  
  E. Karatsivos, J. Svensson, O. Samuelsson
- Real-time Implementation of Optimal Power Flow Calculator for HVDC Grids  
  M.H. Fidai, D. Babazadeh, J. Hanning, T.X. Larsson, L. Nordström