



**UPEC
2016**

**Coimbra
Portugal**

51st

**INTERNATIONAL
UNIVERSITIES
POWER ENGINEERING
CONFERENCE**

IPC/ISEC, POLYTECHNIC INSTITUTE OF COIMBRA
COIMBRA INSTITUTE OF ENGINEERING, PORTUGAL

6-9 SEPTEMBER 2016

 **POLITÉCNICO
DE COIMBRA**

 **ISEC[®]
ENGENHARIA**

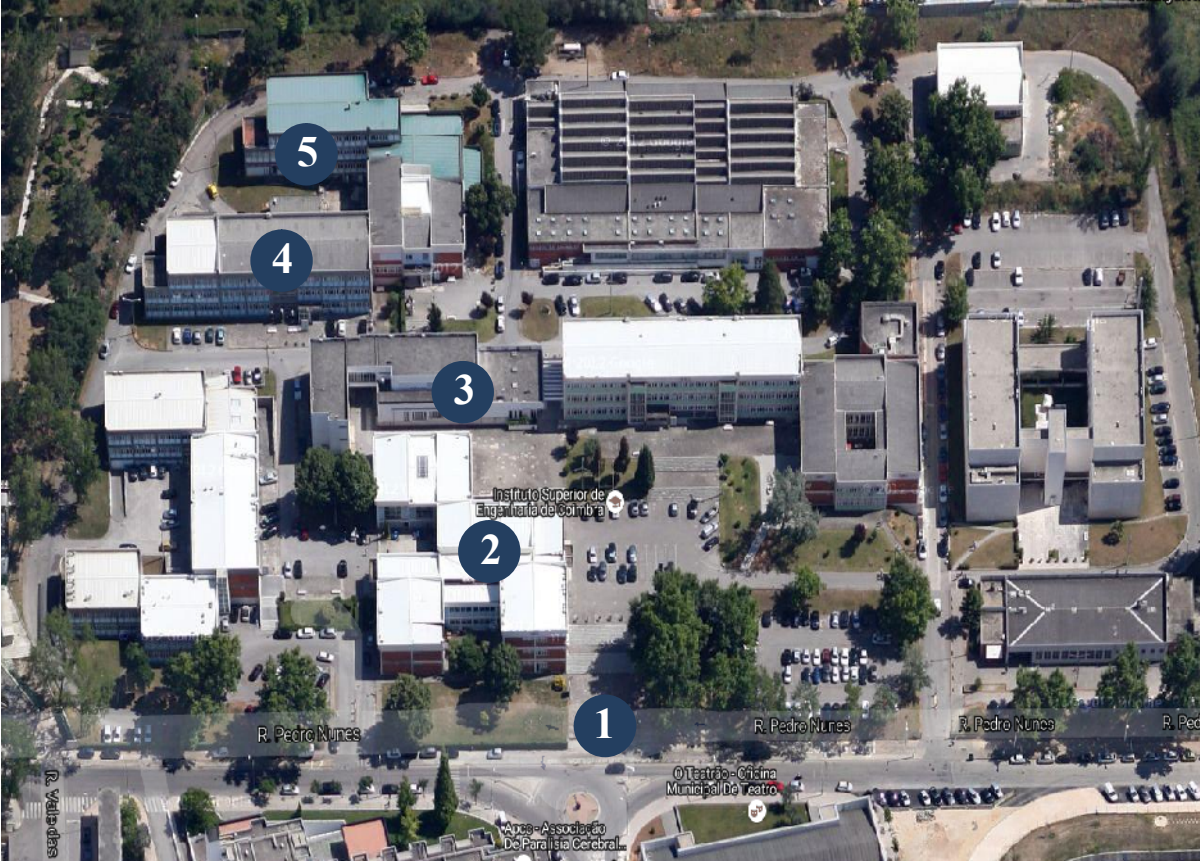


Contents

Instituto Superior de Engenharia de Coimbra Campus Map	4
Welcome	5
Committees	6
History of UPEC 1966 – 2016.....	7
Conference Information	9
General Information.....	12
Travel Information.....	14
Social Programme	16
UPEC 2016 – Programme Outline.....	19
Technical Programme	20
Technical Programme Summary	55

Instituto Superior de Engenharia de Coimbra Campus Map

The 51st International Universities Power Engineering Conference, UPEC 2016, will be held in the Instituto Superior de Engenharia de Coimbra (ISEC)/Instituto Politécnico de Coimbra (IPC), Rua Pedro Nunes, Quinta da Nora, Coimbra, Portugal, from 6th to 9th of September 2016 (www.upec2016.com).



Key:

- 1** ISEC Main Entrance
- 2** Multipurpose Room
- 3** Auditorium
- 4** DEE, Department of Electrical Engineering
- 5** EM Building, Electromechanical Engineering Building

Welcome

It is with great pleasure that the Instituto Politécnico de Coimbra, (Polytechnic Institute of Coimbra), the Instituto Superior de Engenharia de Coimbra (Coimbra Institute of Engineering) and the International Steering Committee welcome you to the 51st International Universities Power Engineering Conference (UPEC 2016) to be held in the Instituto Superior de Engenharia de Coimbra, Rua Pedro Nunes, Quinta da Nora, Coimbra, Portugal, from 6th to 9th of September 2016.

UPEC is a long-established international conference which provides a major forum for scientists, young researchers, PhD students and engineers worldwide to present, review and discuss the latest developments in Electrical Power Engineering. This is the first time that UPEC will be held in Coimbra. The Local UPEC Organising Committee is very pleased to welcome friends and colleagues to Portugal in 2016. Given the major challenges now facing the electrical power industry and the energy sector in general, this conference provides an ideal opportunity to address some of these challenges. It also provides the opportunity to network and to meet experts in these areas.

The high number of contributions submitted to UPEC 2016 is testimony to its continuing appeal. An impressive number of abstracts/full papers (330 from more than 50 countries) were submitted despite the economic decline in Europe along with many countries facing unstable security and the presence of other qualified international conferences held worldwide within the same year. After a two stage review process performed by international referees a very attractive final technical programme incorporating 207 papers was established. This denotes the very high level of scientific activity in our fields of research and the vitality and strength of our community. These papers will be orally presented over 35 technical presentation sessions. The technical presentation sessions are spread over seven time slots with each having five parallel sessions.

The Local Organising Committee has made every effort to ensure that your stay in Coimbra is both professionally rewarding and socially enjoyable. We have arranged a number of events including a Welcome Dinner, various cultural and technical visits, a Civic Reception and a Conference Banquet. The conference has also been enhanced by the participation of our sponsors and supporters to whom many thanks are due. The Local Organising Committee is very grateful to our invited speakers at the various events and last but not least thankful to the Authors for their continued efforts and the high quality of the communications and work presented. The Local Organising Committee and I wish you a successful conference and very pleasant and enjoyable stay in the city of Coimbra.

Prof. Carlos Ferreira
UPEC 2016 Chair

Committees

Executive Committee

Prof. Dan D. Micu (Romania), Prof. Moofik Al-Tai (UK), Prof. Carlos Ferreira (Portugal) and Dr. George Kiriakidis (Greece)

International Steering Committee

Prof. M. Al-Tai (UK)	Prof. D.D. Micu (Romania)
Dr. A. Anuchin (Russia)	Prof. P. Mikropoulos (Greece)
Dr. N. Barry (Ireland)	Prof. N. Nagaoka (Japan)
Dr. R. Biernatzki (Germany)	Dr. H. Nouri (UK)
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Prof. G. Chicco (Italy)	Dr. I. Pisica (UK)
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Prof. M. Haddad (UK)	Prof. C. Stassinopoulos (Greece)
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Dr. G. Kiriakidis (Greece)	Prof. R. Turri (Italy)
Dr. Cuneyt Ozveren (UK)	Dr. Y. Vagapov (UK)

Local Organising Committee

Prof. Carlos Ferreira (Chair)	Prof. Inácio Fonseca
Prof. Adelino Pereira	Prof. Manuel Valdez
Prof. Cristina Agreira	Prof. Marina Perdigão
Prof. Dulce Coelho	Prof. Rita Pereira

Web Page Design

Serviço de Gestão da Infraestrutura Tecnológica

History of UPEC 1966 – 2016

The first recorded UPEC related event was a power systems academic research community meeting held in 1966 in Newcastle. As a consequence of this meeting the UPEC series began the following year hosted by the University of Glasgow and a first full set of proceedings was also then published. UPEC was originally established as a University led conference series and has therefore always been hosted at universities both within and outside the UK. The first time UPEC was hosted outside the UK was in 1994 when it was hosted in Galway, Ireland. Since then UPEC has become more internationally established and has been held in countries such as Greece, Italy, Germany, Romania and most recently Portugal. The 52nd International Universities Power Engineering Conference, UPEC 2017, will be hosted by the University of Crete situated in Heraklion, Crete, Greece.

UPEC	Year	University	Place	Country
51 st	2016	Polytechnic Institute of Coimbra	Coimbra	Portugal
50 th	2015	Staffordshire University	Stoke-on-Trent	England, UK
49 th	2014	Technical University of Cluj-Napoca	Cluj-Napoca	Romania
48 th	2013	Dublin Institute of Technology	Dublin	Ireland
47 th	2012	Brunel University	West London	England, UK
46 th	2011	South Westphalia University	Soest	Germany
45 th	2010	Cardiff University	Cardiff	Wales, UK
44 th	2009	University of Strathclyde	Glasgow	Scotland, UK
43 rd	2008	University of Padova	Padova	Italy
42 nd	2007	University of Brighton	West Sussex	England, UK
41 st	2006	Northumbria University	Newcastle	England, UK
40 th	2005	University College Cork	Cork	Ireland
39 th	2004	University of West England	Bristol	England, UK
38 th	2003	Aristotle University of Thessaloniki	Thessaloniki	Greece
37 th	2002	Staffordshire University	Stafford	England, UK
36 th	2001	University of Wales	Swansea	Wales, UK
35 th	2000	Queens University Belfast	Belfast	N. Ireland, UK
34 th	1999	University of Leicester	Leicester	England, UK
33 rd	1998	Napier University	Edinburgh	Scotland, UK
32 nd	1997	University of Manchester	Manchester	England, UK

UPEC	Year	University	Place	Country
31 st	1996	Technological Educational Inst.	Iraklio	Greece
30 th	1995	University of Greenwich	London	England, UK
29 th	1994	University College Galway	Galway	Ireland
28 th	1993	Staffordshire University	Stafford	England, UK
27 th	1992	University of Bath	Bath	England, UK
26 th	1991	Brighton Polytechnic	Brighton	England, UK
25 th	1990	The Robert Gordon University	Aberdeen	Scotland, UK
24 th	1989	Queens University Belfast	Belfast	N. Ireland, UK
23 rd	1988	Trent Polytechnic	Trent	England, UK
22 nd	1987	Sunderland Polytechnic	Sunderland	England, UK
21 st	1986	Imperial College London	London	England, UK
20 th	1985	Huddersfield Polytechnic	Huddersfield	England, UK
19 th	1984	University of Dundee	Dundee	Scotland
18 th	1983	University of Surrey	Surrey	England, UK
17 th	1982	University of Manchester	Manchester	England, UK
16 th	1981	University of Sheffield	Sheffield	England, UK
15 th	1980	University of Leicester	Leicester	England, UK
14 th	1979	Loughborough University	Leicester	England, UK
13 th	1978	University of Southampton	Southampton	England, UK
12 th	1977	Brunel University	West London	England, UK
11 th	1976	University of Southampton	Southampton	England, UK
10 th	1975	University of Aston	Birmingham	England, UK
9 th	1974	University of Cambridge	Cambridge	England, UK
8 th	1973	University of Bath	Bath	England, UK
7 th	1972	University of Bradford	Yorkshire	England, UK
6 th	1971	University of Manchester	Manchester	England, UK
5 th	1970	University of Swansea	Swansea	Wales, UK
4 th	1969	University of Nottingham	Nottingham	England, UK
3 rd	1968	Queen Mary College	London	England, UK
2 nd	1967	University of Glasgow	Glasgow	Scotland, UK
1 st	1966	Meeting	Newcastle	England, UK

Conference Information

Location

UPEC 2016 will be held in the Instituto Superior de Engenharia de Coimbra (ISEC)/Instituto Politécnico de Coimbra (IPC), Rua Pedro Nunes, Quinta da Nora, 3030-199 Coimbra, Portugal (GPS: N 40 11.575 W 8 24.698).

The conference will start with registration on Monday 5th of September at 14:30 and will end mid-afternoon on Friday 9th of September 2016. The conference programme will be available on the conference website at: www.upec2016.com, prior to the start of the conference.



Language

English will be the conference language.

Proceedings

Each registered participant will receive a USB drive containing the papers presented during the technical sessions.

Name Badges

A name badge will be provided to each participant. The name badge will allow access to sessions and other associated conference events. The name badge must be worn at all times throughout the duration of the conference.

Participant List

A list of pre-registered participants will be included in the conference bag.

Conference Registration

Conference registration will take place at the ISEC Auditorium on Monday 5th of September 2016 from 14:30 to 19:30. On subsequent days, registration will be open from 9:00 to 17:00.

It is recommended that participants register prior to the conference to avoid any delays when arriving on-site. Upon registration, participants will receive a Delegate Pack including a Conference Programme, USB drive complete with all of the proceedings and various other useful items. Full payment is required to complete registration. Further information will be provided at the Registration Desk.

Please register for the conference using the Registration Form provided on the conference website available at: www.upec2016.com.

To pay for your attendance, on the conference website click in the Bank Transfer form button, complete the form and return it through your Finance Department. All charges are to be paid by the Sender. The copy of the Bank Transfer receipt should be sent by email to the UPEC 2016 Secretariat at: upec2016@isec.pt.

Registration Fees

Registration for the conference includes attendance of technical sessions and invited lectures, all coffee breaks, lunch, two evening receptions, conference banquet, social/technical visit, transport to and from venues and delegate pack. The Conference Fees are as follows:

UPEC 2016	Early Registration	Late Registration
CONFERENCE FEES	Payment received on and before 26 July 2016	Payment received after 26 July 2016
IET and IEEE Members	€450	€500
Non-members of IET/IEEE	€500	€550
IEEE Student Members	€270	€320
Student	€320	€370
Accompanying person	€175	

Please note that student registration must be accompanied by a letter from Head of Department/School/Institute confirming full-time student status. Authors must register and present their papers at the conference. Failure to pay correct conference fee will exclude the paper from the conference proceedings. Registration for the Accompanying person includes welcome dinner, civic reception, conference banquet and technical/cultural visit. Participants without papers submitted can attend the conference by registering and paying registration fees.

Cancellation, Replacements and Refunds

All cancellations of Conference Registration, which must include your full bank account details, should be sent in writing to the UPEC2016 Conference Chair. Cancellations received no later than 9 August 2016 will be refunded in full EXCEPT for the administrative fee of €50. Refund requests received after 9 August 2016 may not be considered.

Accommodation

Coimbra has many hotels located at a walking distance of public transportations which will take you to the Conference site. Please, find at the conference website a list of pre-booked hotels with reduced fees for the conference.

General Information

Location

ISEC is located in the historical city of Coimbra, one of the most important urban centres in Portugal. On the banks of the river Mondego, Coimbra is one of the most enchanting Portuguese cities famous for its University, monuments, churches, museums, parks and cultural life. Coimbra is known for its University, the oldest in Portugal and one of the oldest in Europe, which over time has shaped its image to become "the city of students". The University of Coimbra, the uptown ("Alta") and "Rua da Sofia" were classified by UNESCO as World Heritage sites.

Local Time

UTC/GMT + 1 hour: (Western Europe Daylight at Summer Time). The Local Time is according to the Universal Time Coordinated (UTC)/Greenwich Mean Time (GMT).

Climate

In general, the climate tends to be temperate all year, with long hot summers, mild springs and autumns, and relatively mild winters, although temperatures and weather conditions are marked by strong local differences. When you travel to Portugal visit the IPMA – Instituto Português do Mar e da Atmosfera/Portuguese Sea and Atmosphere Institute website (<http://www.ipma.pt/en/index.html>) to prepare yourself to the trip.

Currency

Euro (€) is the currency used in Portugal, as in the most European countries. Banks offer normal currency exchange services and most establishments accept credit and debit cards.

ATMs - Automatic Teller Machines (Multibanco): Portugal has a national network of cash machines (ATMs) identified by the symbol MB (Multibanco), from which you can withdraw cash 24 hours a day.

Currency Exchange: you can exchange money at banks, which are open from 8.30 a.m. to 3 p.m. five working days a week; at bureau de change; and at automatic currency exchange machines (these are for currency sale transactions only).

Credit cards: in Portugal, the most commonly used credit cards are Visa, American Express, Diners Club, Europay/MasterCard, JCB and Maestro.

Sales Tax

Sales Tax, VAT (Value Added Tax), is included in prices quoted. Visitors to Portugal who are not resident in any of the European Union member states can be reimbursed for the VAT paid on purchases that they have made in Portugal and are being transported in their personal luggage. For non European Union residents, tax free shopping schemes are available in many shops, which give substantial savings to visitors.

Health

If you require medical assistance contact the local Health Centre. Hospital emergency services should be used only in serious situations (serious injury, poisoning, burns, infarction, thromboses, breathing difficulties, ...).

In case of illness or accident while visiting Portugal, Nationals from the 27 European Union countries, Iceland, Liechtenstein, Norway or Switzerland are entitled to free or reduced-cost healthcare (the same benefits as Portuguese citizens). In order to have access to health services, citizens from the above-mentioned countries, who are not resident in Portugal, must produce their European Health Insurance Cards (issued by the origin country) together with passports or identity cards.

Health Requirements: people from areas where yellow fever is endemic will need to present the vaccination certificates.

Pharmacy: pharmacies are open on weekdays between 9 a.m. and 7 p.m. (some close for lunch from 1 to 3 p.m.) and on Saturdays between 9 a.m. and 1 p.m. In every area you can find one that is open 24 hours. The symbol for pharmacy is a white cross on green background. They display an illuminated green cross outside when open at night. All pharmacies have information posted on the door indicating the nearest pharmacies that are open at night.

Emergency Number: in case of emergency call 112.

Local Opening Hours

Banks: banks are open from 8.30 a.m. to 3 p.m. five working days a week.

Post Offices: in general, post offices are open from Monday to Friday, from 9 a.m. to 6 p.m. More detailed information about opening hours and services available at each office can be found on www.ctt.pt

Shops: Traditionally, shops are open from Monday to Friday, from 9 or 10 a.m. to 7 p.m. Some close for lunch from 1 to 3 p.m. On Saturdays, shops generally close at 1 p.m.

Shopping Centers: there are plenty of shopping centers inside and outside the cities that are usually open from 10 a.m. to midnight every day of the week. They generally have stores with the main international brands.

Traditional shops: Portuguese products can be found particularly in the streets of the older neighborhoods of towns and cities.

Smoking

The Portuguese law, in accordance with Regulations of European Union, does not allow smoking in any public transportation or in any closed public areas (some restaurants and bars may have a designated smoking area).

Electricity

The electric current in Portugal is 230/400 volts at a frequency of 50 Hz and sockets comply with European standards (with two pins).

Travel Information

Travelling to Coimbra

Coimbra is easily accessible by highway or railway. It is located between Oporto (OPO) and Lisbon (LIS) airports, and linked to main Portuguese cities by train or express buses.

By Air: Portugal makes part of the network of the major international airlines, so it is easy to find frequent and regular connections from all parts of the world. The airports nearer to Coimbra are located in Lisboa (190 km away) and in Porto (120 km away).

Arrival Points: Lisboa – Lisbon Humberto Delgado Airport
Porto – Francisco Sá Carneiro Airport

Airlines and Destinations: ANA - Aeroportos de Portugal (Airports of Portugal) is the Portuguese airport authority and provides departure and arrival information on www.ana.pt.

From Lisboa (Humberto Delgado) International Airport:

By train: you will need to take the Metro (Underground) or to catch a taxi to Lisboa-Oriente railway station; the journey should take approximately 10 minutes and cost 8 Euros. Trains to Coimbra run every hour and you should expect the journey to take approximately 2 hours. The price of one ticket in the Intercity train should cost around €24.30/€19.20 (Price 1st/2nd class) and for Alfa Pendular train should cost around €32.80/€22.80 (Price 1st/2nd class). For more information, please check Portuguese train company website: www.cp.pt.

By express bus: you will need to catch a taxi to “Sete Rios” Bus Station; the journey should take approximately 10 minutes and cost 10 Euros. Express buses to Coimbra run every hour and you should expect the journey to take approximately 2 hours and a half. The price of ticket should cost around €15.

Please, check the website of the express buses network to check the timetable and prices (www.rede-expressos.pt).

By car: when leaving the airport you should take the A1 motorway to Coimbra and exit in “Coimbra Sul”. You should expect the journey to take 2 hours.

From Porto (Francisco Sá Carneiro) International Airport:

By train: from Porto airport you will need to travel to “Gare da Campanhã” (the main train station in Porto). It is recommended that you travel to this station by taxi or Metro. You will find taxis readily available at the front of the airport and the underground station as well. You should expect the journey to take approximately 30 minutes by taxi and about one hour by Metro. Several trains run from Porto to Coimbra daily. You should expect the journey to take 1 hour and 10 minutes. The price of one ticket in the Intercity train should cost around €17.20/€13.20 (Price 1st/2nd class) and for Alfa Pendular train should cost around €21.70/€16.70 (Price

1st/2nd class). For more information, please check Portuguese train company website: www.cp.pt.

By express bus: you will need to travel by metro (line E) until the “Bolhão” Stop (25 minutes). From there, you can catch a taxi or walk to the Bus Station “Garagem Atlântico”, Street: “Rua Alexandre Herculano” (8 minutes). Express buses to Coimbra run every hour and you should expect the journey to take approximately 1 hour and a half. The price of ticket should cost around 13 euros.

Please, check the website of the express buses network to check the timetable and prices (www.rede-expressos.pt).

By car: when leaving the airport you should take the A1 motorway to Coimbra and exit at “Coimbra Norte”. You should expect the journey to take 1h:15m.

Local Transportation in Coimbra

When arriving at Coimbra-B railway station, there are two options:

- Taking an urban train (departs every 15 minutes) to the downtown railway station called Coimbra-A. The cost of the urban train is included in the train’s ticket to Coimbra-B. Then, take a taxi to the hotel/meeting place.
- Simply catching a taxi at Coimbra-B railway station and going to the hotel/meeting place.

Getting to the Conference Venue

Arriving at the venue using city buses, from within Coimbra:

ISEC is served by two city buses: line 24T (Palácio da Justiça-Quinta da Nora) and line 33 (Portagem-Manutenção). Line 24T is the most convenient whenever you are in the city center (downtown). From ISEC to the city center you can also use line 24 (Arnado-Quinta da Nora). Timetables are available at: www.smtuc.pt/.

Taxis

Taxi arrangements can be made with the Registration Desk.

Insurance

Participants are strongly advised to arrange appropriate travel and health insurance. The registration fees do not include insurance cover of any kind. The Organising Committee and accept no responsibility for loss in this regard.

Additional Information

For more information please visit:

<https://www.visitportugal.com/en>

<http://www.visitcentro.com/>

Social Programme

Monday, 05 September 2016

All conference participants are warmly invited to attend a buffet held on Monday the 5 September of 2016. The buffet will be held at ISEC between 20:00 to 22:00. Buses will depart from ISEC to Coimbra city centre (hotels) at 22:00.

Tuesday, 06 September 2016

All conference participants are warmly invited to attend a welcome dinner held on Tuesday the 6 September of 2016. The dinner will be held at Tryp Meliá Coimbra between 20:00 to 23:00. This is a good and positive environment to meet old friends and make new ones.

Wednesday, 07 September 2016

Technical Visit: Aguieira Hydroelectric Power Plant

The hydroelectric power plants of EDP - Gestão da Produção de Energia, S.A. which is integrated into the EDP Group, are distributed by three large Production Centres: Cávado-Lima, Douro and Tejo-Mondego. Aguieira, Raiva and Caldeirão are three of the fifteen large power plants that compose the Tejo-Mondego Production Centre. The basin of the river Mondego, which has its source in the mountain of Estrela nearly 1450 m high (is the most important river that has the source and a complete flowing across the Portuguese territory), is located in the central Portugal and is approximately 232 km long up to the Atlantic ocean at the Figueira da Foz. The Aguieira-Raiva-Fronhas hydro schemes are multipurpose plants aimed to produce electricity and regulate the flows as a part of a General Plan for the Mondego basin. The scheme of Aguieira includes a multiple arch dam with two central buttresses where two flood dischargers are installed. The powerhouse is equipped with three 100 MVA turbine/pumping reversible generators and has closed the substation with three single phase transformers, 3x36 MVA, and the 220 kV outlets for connection to the national grid.



Cultural Visit: Conimbriga Museum and Ruins

The archaeological evidence tells us that Conimbriga was inhabited, at least, between the IX century B.C. and VII-VIII a.D. When the Romans arrived, in the second half of the I st century B.C., Conimbriga was a florescent village. Thanks to the peace established in Lusitania a quick romanisation of the indigenous population was took place and Conimbriga became a prosperous town. Following the deep political and administrative crisis of the Empire, Conimbriga suffered the consequences of the barbaric invasions. In 465 and in 468 Suabii captured and plundered partially the town, abandoned by part of its population. Conimbriga nowadays is an area designated as national monument, defined by ordnance in 1910. More information at: www.conimbriga.pt



Cultural Visit: Buçaco Woods

At the far end of Buçaco Mountain, where the highest range is 547 meters high, you'll find Buçaco Woods, surrounded by a high wall with eleven entrance doors, making them a perfect starting point for a stroll through Nature in the region and fall in love with the serene exuberance, almost magical, of Buçaco's intense green colour. The Bussaco Palace Hotel is one of the most beautiful neo-Manueline buildings in Portugal. During the Battle of Buçaco General Wellington spent the night on the Santa Cruz Convent. Buçaco Woods are very small when compared with other large European woods. However, the variety of its plant species is larger than in other wood. Within the walls built by the Carmelites, there are about 400 native species of the Portuguese Atlantic coast and around 300 which come from other climates. The most representative element of this symbiosis is the Buçaco cedar, an important cypress which comes from Mexico and might have been the first exotic species to be planted in the forest by the monks in 1656. The Saint Joseph Cedar, planted 350 years ago by the monks next to the door with the same name, is the local symbol of this majestic species of trees. More information at: www.visitcentrodeportugal.com.pt



Cultural Visit: Coimbra (walking tour)

The University of Coimbra, the uptown (“Alta”) and Sofia were classified by UNESCO as World Heritage sites. Situated on a hill overlooking the city, the University of Coimbra with its colleges grew and evolved over more than seven centuries within the old town. Notable university buildings include the 12th century Cathedral of Santa Cruz and a number of 16th century colleges, the Royal Palace of Alcáçova, which has housed the University since 1537, the Joanine Library with its rich baroque decor, the 18th century Botanical Garden and University Press.

In the shopping area and area of historic cafés in the city centre, visitors can see the Monastery of Santa Cruz, which houses the tomb of the first King of Portugal, Afonso Henriques, and on the other bank, the Monastery of Santa Clara-a-Velha, recovered and rescued from the waters of the river that invaded it over the centuries. Founded during the reign of Afonso Henriques, Coimbra’s Old Cathedral represents, through its monumentality, the austere magnitude of the Romanesque architecture. It is seen as a treasure of the Portuguese Romanesque Style and is the only Portuguese cathedral built during the Reconquista era which has remained intact until today. If “Coimbra is a lesson”, as the popular fado song says, Coimbra is firstly a lesson of Portuguese History. More information at: www.visitcentrodeportugal.com.pt

Civic Reception

Coimbra City Hall will be hosting a Civic Reception for all participants on Wednesday the 7th of September 2016 starting at 19:30. The Coimbra City Hall is situated on "Praça 8 de Maio" and about 5 to 10 minutes walking distance from the city center hotels.

Thursday, 08 September 2016

The Conference Banquet will take place in “Quinta do Ribeiro” on the evening of Thursday 8th September 2016 starting at 20:00. Buses will depart from ISEC at 19:30.



UPEC 2016 – Programme Outline

Monday, 05 September

14:00-19:30	Registration	Auditorium
20:00-22:00	Welcome Reception	

Tuesday, 06 September

08:30-10:00	Registration	Auditorium
10:00-11:00	Opening Ceremony and Keynote Address	Auditorium
11:00-11:30	Coffee Break	Multipurpose Room
11:30-12:30	Invited Lecture 1	Auditorium
12:30-14:00	Lunch	
14:00-15:30	Paper Sessions PS1 - PS5	DEE/EM Building
15:30-16:00	Coffee Break	Multipurpose Room
16:00-17:30	Paper Sessions PS6 - PS10	DEE/EM Building
17:30-18:30	Steering Committee Meeting	Américo Pinto Theatre
20:00-23:00	Welcome Dinner	Tryp Mélia Coimbra

Wednesday, 07 September

09:00-10:30	Paper Sessions PS11 - PS15	DEE/EM Building
10:30-11:00	Coffee Break	Multipurpose Room
11:00-12:00	Invited Lecture 2	Auditorium
12:00-13:30	Lunch	
13:30-18:00	Technical and Cultural Visits	
19:30-21:30	Civic Reception	Coimbra City Hall

Thursday, 08 September

09:00-10:30	Paper Sessions PS16 - PS20	DEE/EM Building
10:30-11:00	Coffee Break	Multipurpose Room
11:00-12:30	Paper Sessions PS21 - PS25	DEE/EM Building
12:30-14:00	Lunch	
14:00-15:30	Paper Sessions PS26 - PS30	DEE/EM Building
15:30-16:00	Coffee Break	Multipurpose Room
16:00-17:30	Invited Lecture 3	Auditorium
20:00-23:30	Conference Banquet	Quinta do Ribeiro

Friday, 09 September

09:30-11:00	Paper Sessions PS31 - PS35	DEE/EM Building
11:00-11:30	Coffee Break	Multipurpose Room
11:30-12:30	Closing Ceremony	Auditorium
12:30-14:00	Lunch	

Technical Programme

The technical programme consists of Keynote Address, 3 invited lectures and 207 papers included in 35 oral technical presentation sessions spread over 7 time slots with each having 5 parallel sessions.

Tuesday, 06 September 2016

14:00 - 15:30 Parallel Paper Sessions PS1–PS5

Session PS1 **Power Systems Operations and Control (1)**
DEE, Room: Anfiteatro Américo Pinto

Session Chair: Dr. Ioana Pisica, Brunel University London, UK

33 **Distribution Network Reconfiguration for Control of the Demand Contract with Transmission System**
Marco Antônio Ferreira Boaski, Marina Camponogara, Caio dos Santos, Magdiel Schmitz, Daniel Pinheiro Bernardon, Federal University of Santa Maria - UFSM, Santa Maria, Brazil
Daniel Porto, Maicon Jaderson Ramos, Everson Remi Malysz, AES Sul Power Utility, São Leopoldo, Brazil

39 **Offline Transmission System Analysis with Reduced Distribution Networks**
A. Z. M. Shahriar Muttalib, Gareth Taylor, Brunel University London, UK
Ali Ahmed, Martin Bradley, National Grid, UK

161 **Overview of On-line and Off-line Ampacity Identification Techniques of Bare Overhead Transmission Line**
A. Abdaelbaset, Mohamed Farrag, Shahab Farokhi, Donald Hepburn, Glasgow Caledonian University, UK

285 **Grid Frequency Support by Single-Phase Electric Vehicles Employing an Innovative Virtual Inertia Controller**
Michel Rezkalla, Antonio Zecchino, Michael Pertl, Mattia Marinelli, DTU - Technical University of Denmark

383 **Probabilistic Optimal Power Flow Approach Considering Correlated Loads based on Latin Hypercube Sampling**
M. Mohammadi, A. Shabanpour-Haghighi, University of Shiraz, Iran

396 **A Review of Novel Decentralised and Distributed Control Techniques for LV Network Storage**
Anthony Florida-James, Graeme Burt, Stephen McArthur, University of Strathclyde, UK

Tuesday, 06 September 2016

14:00 - 15:30 Parallel Paper Sessions PS1–PS5

Session PS2 **Electrical Services for Buildings (1)**
DEE, Room: Anfiteatro A2

Session Chair: Prof. George Kiriakidis, University of Crete, Greece

121 **The Role of Residential HVAC Units in Demand Side Flexibility Considering End-User Comfort**

Ozan Erdinc, Akin Tascikaraoglu, Yavuz Eren, Yildiz Technical University, Turkey

Nikolaos G. Paterakis, Madeleine Gibescu, Eindhoven University of Technology, The Netherlands

João P. S. Catalão, INESC TEC and FEUP, Porto, C-MAST/UBI, Covilhã, and INESC-ID/IST-UL, Lisbon, Portugal

180 **Assessment of Energy Efficient Retrofitting Measures in the Residential Building Sector**

Telmo Carapeto, IPC/ISEC, Coimbra, Portugal

Dulce Coelho, IPC/ISEC and INESC Coimbra, Portugal

Carla Oliveira, IPC/ISCAC and INESC Coimbra, Portugal

319 **Asymmetries of Earthing Arrangements and Equipotential Bonding Systems in Buildings and the Effects on EMC**

Wolfgang Emmer, Ernst Schmutzner, Institute of Electrical Power Systems, Graz University of Technology, Graz, Austria

Karl Tiran, Tiran Trading GmbH, Leibnitz, Austria

347 **Optical Wavelength Ratiometric Monitoring System for Data Centre CWDM Applications**

Anthony Colohan, Thomas Freir, Dublin Institute of Technology, Ireland

Derek Finlay, Wood Communications, Ireland

376 **Simulation Platform for Autonomous Zero-Net Electricity Network**

F. Gonzalez-Longatt, Loughborough University, UK

B. S. Rajpurohit, IIT Mandi, India

S.N. Singh, IIT Kanpur, India

Tuesday, 06 September 2016

14:00 - 15:30 Parallel Paper Sessions PS1–PS5

Session PS3 **ICT for Future Electricity Grids**
DEE, Room: E021

Session Chair: Prof. Gareth Taylor, Brunel University London, UK

80 **Implementing a Distributed Firewall using a DHT Network Applied to Smart Grids**

Alexandre Silva Rodrigues, Tiago Antonio Rizzetti, Luciane Neves Canha, Rafael Gressler Milbradt, Yagor Santos Duarte, UFSM, Universidade Federal de Santa Maria, Brazil
Sergio Fabbrin Appel, CEEE-D, Brazil

137 **Analysing Smart Grid Technologies using a Novel SWOT Methodology**

Alan Birch, Lutz Itschert, Anna Bellot, DNV GL, UK

275 **Study of Missing Meter Data Impact on Domestic Load Profiles Clustering and Characterisation**

Sima Davarzani, Ioana Pisica, Gareth A. Taylor, Institute of Energy Futures, Smart Power Networks, Brunel University London, UK

298 **An Innovative Information and Communication Technology Architecture to the V2G Concept Implementation**

Victor D. N. Santos, Paulo F. Tavares, IPC/ISEC and INESC Coimbra, Coimbra, Portugal
José M. R. Gonçalves, IPC/ISEC, Coimbra, Portugal

338 **Economic Comparison of Electric Vehicles Performing Unidirectional and Bidirectional Frequency Control in Denmark with Practical Validation**

Andreas Thingvad, Sergejus Martinenas, Peter Bach Andersen, Mattia Marinelli, Ole Jan Olesen, DTU – Technical University of Denmark
Bjoern E. Christensen, NUVVE Corporation, El Cajon, California, USA

373 **Evaluation of Electric Vehicle Charging Controllability for Provision of Time Critical Grid Services**

Sergejus Martinenas, Mattia Marinelli, Peter Bach Andersen, Chresten Træholt, DTU – Technical University of Denmark

Tuesday, 06 September 2016

14:00 - 15:30 Parallel Paper Sessions PS1–PS5

Session PS4 **Distributed Generation**
DEE, Room: LSEE

Session Chair: Prof. Gianfranco Chicco, Polytechnic Politecnico di Torino, Italy

19 **CHP Sizing and Domestic Building Energy Cost Optimization**

Dongmin Yu, Huiming Zhang, Da Huo, Simon Le Blond,
University of Bath, UK

62 **Portugal as a Producer of Biomass Fuels for Power Production: an Analysis of Logistic Costs Associated to Wood Pellets Exportation**

Catarina Faria, Susana Azevedo, University of Beira Interior,
Covilhã, Portugal
Leonel Nunes, DEGEIT, University of Aveiro, Campus Universitário
de Santiago, Aveiro, Portugal

99 **Diversification of Brazilian Energy Matrix by Connecting Distributed Generation Sources Fuelled by Biogas from Swine Manure**

Wagner Brignol, Luciane Canha, Rodrigo de Azevedo, Alexandre Barin,
Universidade Federal de Santa Maria, Brazil
Dalvir Maguerroski, Eletrosul, Brazil

118 **Strategy for the Management of Service Orders in Electrical Energy Concessionaires**

Leonardo Marques Caires, Vinícius Jacques Garcia,
Universidade Federal de Santa Maria, Brazil

416 **Methodology for Analysis of Technical and Economic Feasibility of Distributed Generation Application in a University's Microgrid**

Max Henrique G. Braunstein, Maurício Sperandio, Daniel Pinheiro
Bernardon, Universidade Federal de Santa Maria, Brazil

420 **Analysis of Distributed Generation Impact on the Voltage Stability Margin**

Carolina Cortez do Prado, Daniel Pinheiro Bernardon, Camilla Leimann
Pires, Cricièle Castro Martins, Felipe Cirolini Lucchese,
Universidade Federal de Santa Maria, Brazil

Tuesday, 06 September 2016

14:00 - 15:30 Parallel Paper Sessions PS1–PS5

Session PS5 **HVDC, FACTS and Power Electronics (1)**
EM Building, Room: Anfiteatro EM

Session Chair: Dr. Mohamed E. Farrag, Glasgow Caledonian University, UK

56 **Gate Impedance Characterization and Performance Evaluation of 3.3 kV Silicon Carbide MOSFETs**

Maria Rodriguez, Kevin Martin, Abraham Lopez, Alberto Rodriguez, Javier Sebastian, University of Oviedo, Asturias, Spain

65 **Hybrid Series-Parallel PWM Dimming Technique for Integrated-Converter-Based HPF LED Drivers**

Guirguis Zaki Abdelmessih, J. Marcos Alonso, University of Oviedo, Asturias, Spain

Marina S. Perdigão, Instituto de Telecomunicações, IPC/ISEC, Coimbra, Portugal

104 **The Impact of UPFC on Power Swing Blocker**

Jalal Khodaparast, M. Khederzadeh, Shahid Beheshti University, Iran
Filipe Faria da Silva, Claus Leth Bak, Aalborg University, Denmark

128 **A Review of AC/DC Converter Based Power Flow Control Methods in Multi-terminal HVDC Grids**

Hatem Diab, Mahmoud Abdelsalam, Sarath Tennakoon, Christopher Gould, Staffordshire University, Stoke-on-Trent, UK

130 **Real Time Simulation of a Current Flow Controller for HVDC Grid Applications**

Hatem Diab, Staffordshire University, UK

Mostafa Marei, Ain Shams University, Cairo, Egypt

Mahmoud Abdelsalam, Sarath Tennakoon, Christopher Gould, Staffordshire University, Stoke-on-Trent, UK

131 **Detection and Diagnosis of Sub-Module Faults for Modular Multilevel Converters**

Mahmoud Abdelsalam, Staffordshire University, Stoke-on-Trent, UK

Mostafa Marei, Ain Shams University, Cairo, Egypt

Hatem Diab, Sarath Tennakoon, Alison Griffiths, Staffordshire University, Stoke-on-Trent, UK

Tuesday, 06 September 2016

16:00 - 17:30 Parallel Paper Sessions PS6–PS10

Session **PS6** **Protection Systems (1)**
DEE, Room: Anfiteatro Américo Pinto

Session Chair: Prof. Roberto Turri, University of Padova, Italy

21 **Application Oriented Testing of Power Transmission Lines and Fault Clearing**

Michael O'Donovan, Noel Barry, Cork Institute of Technology, CIT,
Cork, Ireland
Eoin Cowhey, ESB International, Ireland

70 **Applying Exact MILP Formulation for Controlled Islanding of Power Systems**

Panayiotis Demetriou, Alexis Kyriacou, Elias Kyriakides,
Christos Panayiotou, KIOS Research Center for Intelligent
Systems and Networks, University of Cyprus, Nicosia, Cyprus

81 **Fault Analysis of an Active LVDC Distribution Network for Utility Applications**

Dong Wang, Abdullah Emhemed, Graeme Burt, Patrick Norman,
University of Strathclyde, Glasgow, UK

201 **Optimal Geographical Placement of Phasor Measurement Units based on Clustering Techniques**

Diego Carrión, Esteban Inga, Universidad Politécnica Salesiana,
Quito, Ecuador
Jorge W. Gonzalez, Roberto Hincapié, Universidad Pontificia Bolivariana,
Medellín, Colombia

239 **Modelling the Effect of Ground Return Fasteners on Current Distribution and Power Dissipation in Carbon Composite Test Samples Subjected to Lightning Strikes**

Giuseppe Mastrolembro, A. Manu Haddad, David Clark, Morgan Botti
Lightning Laboratory, Cardiff University, UK
Matthew Cole, Simon Evans, Airbus Group, Newport, Wales, UK

415 **Backup Protection Requirements in Future Low-Inertia Power Systems**

Fangzhu Yu, Campbell Booth, Adam Dyśko,
University of Strathclyde, Glasgow, UK

Tuesday, 06 September 2016

16:00 - 17:30 Parallel Paper Sessions PS6–PS10

Session PS7 **Reliability Analysis**
DEE, Room: Anfiteatro A2

Session Chair: Prof. Berthold Bitzer, South Westphalia University of Applied
Sciences, Germany

45 **SF₆ Gas Circuit Breakers Reliability Estimation, Considering
Likely Wear Points**

Elaine A. L. Vianna, Alzenira R. Abaide, Luciane N. Canha,
Universidade Federal de Santa Maria, Brazil

Priscila L. Vianna, Universidade Federal de Rondônia, Brazil

122 **The Impact of the Installation of Smart Meters on Distribution
System Reliability**

Júlia R. Hammarstron, Alzenira da R. Abaide, Marcelo W. Fuhrmann,
Elaine A. L. Vianna, Universidade Federal de Santa Maria, Brazil

127 **Reliability Enhancement of Modular Multilevel Converter by
Applying Fault Tolerant Control**

Mahmoud Abdelsalam, Hatem Diab, Sarath Tennakoon, Alison Griffiths,
Staffordshire University, Stoke-on-Trent, UK

355 **Probabilistic Security Constrained Fuzzy Power Flow Models**

Eduardo M. Gouveia, Paulo Moisés Costa, ESTGV, Polytechnic Institute
of Viseu, Portugal

Jesus Sagredo, University of Burgos, Spain

Alireza Soroudi, University College Dublin, Ireland

391 **HV Distribution Network Optimum Supply Restoration
Algorithm**

S. Omar, S. Robson, A. Haddad, Cardiff University, UK

H. Griffiths, N. Harid, The Petroleum Institute, Abu Dhabi, UAE

399 **Maintenance Planning and Execution of Protection Systems in
Substations in South Africa: A Recent Case Study**

Macdonald Nko, S.P. Chowdhury, Electrical Engineering Department,
Tshwane University of Technology, Pretoria, South Africa

Tuesday, 06 September 2016

16:00 - 17:30 Parallel Paper Sessions PS6–PS10

Session PS8 **Integration of Renewable Sources (1)**
DEE, Room: E021

Session Chair: Prof. Gianfranco Chicco, Polytechnic Politecnico di Torino, Italy

10 **Grid Code Compliance and Ancillary Services Provision from DFIG and FRC-based wind turbines**

Marios Michas, Carlos E. Ugalde-Loo, Nick Jenkins,
School of Engineering, Cardiff University, UK

98 **Operational Impact of the Complementarity Between Photovoltaic Solar and Biogas Generation Sources on Distribution Network Systems**

Rodrigo de Azevedo, Wagner Brignol, Luciane Canha,
Universidade Federal de Santa Maria, Brazil
Dalvir Maguerroski, Eletrosul, Brazil

120 **Stochastic Modeling of Lead-Acid Battery Parameters**

J. M. Lujano-Rojas, UBI, Covilhã and INESC-ID/IST-UL, Lisbon, Portugal
G. J. Osório, T. D. P. Mendes, C-MAST/UBI, Covilhã, Portugal
J. P. S. Catalão, INESC TEC and FEUP, Porto, C-MAST/UBI, Covilhã,
and INESC-ID/IST-UL, Lisbon, Portugal

260 **Quantitative Assessment of Hybrid Systems of Heating Domestic Water based on Solar Energy in Andean Zones of Ecuador**

Xavier Serrano, Mario Narváez, Christian Urigüen, Universidad
Politécnica Salesiana, Cuenca, Ecuador
Guillermo Escrivá, Universidad Politécnica de Valencia, Spain

369 **A Method for Capacity Designing of a Photovoltaic Power Generation with a Battery Using Annual Total Amount of Solar Radiation Analysis Model**

Tomonori Nakayama, Katsuya Mineno, Nguyen Thi Hoai Thu,
Masayoshi Ishida, University of Tsukuba, Japan

417 **Coordination of Hydro and Wind Power in a Transmission Constrained Area using SDDP**

Espen F. Bødal, Martin Hjelmeland, Camilla T. Larsen, Magnus Korpas,
Norwegian University of Science and Technology, Trondheim, Norway

Tuesday, 06 September 2016

16:00 - 17:30 Parallel Paper Sessions PS6–PS10

Session **PS9** **Power Engineering Education (1)**
DEE, Room: LSEE

Session Chair: Dr. Christopher Gould, Staffordshire University, UK

3 **Development of an Experimental Platform for Analysis of Self-healing Method**

Magdiel Schmitz, Daniel Bernardon, C. Santos, M. A. Boaski,
W. Schmitz, Federal University of Santa Maria, Brazil
D. Porto, M. Ramos, AES Sul Distribuidora Gaúcha de Energia SA,
Power Utility, Brazil

267 **Augmented Reality System for Maintenance of High-Voltage Systems**

Rúben Oliveira, CEMUC, Centre for Mechanical Engineering,
Coimbra, Portugal
José Torres Farinha, Inácio Fonseca, IPC/ISEC and CEMUC,
Centre for Mechanical Engineering, Coimbra, Portugal
F. Maciel Barbosa, FEUP and INESC TEC, Porto, Portugal

305 **Development of a Masters Programme in Electrical Power and Energy Systems at Teesside University**

Gobind Pillai, Neville Winter, Essam S. Hamdi,
Teesside University, Middlesbrough, UK

385 **Enhancing the Quality of Multi-campus Delivery of Engineering Programmes – A Blended Learning Approach**

Essam S Hamdi, Teesside University, Middlesbrough, UK

394 **The Teaching of Electrical and Electronics Engineering at Technical Universities in the World**

Suleyman V. Levinzon, Baumann Moscow State University,
Darmstadt, Germany
Natalia V. Tsarkova, Baumann Moscow State University. Kaluga, Russia

422 **Review on Micro-Energy Harvesting Technologies**

Rhys Edwards, Christopher Gould,
Staffordshire University, Stoke-on-Trent, UK

Tuesday, 06 September 2016

16:00 - 17:30 Parallel Paper Sessions PS6–PS10

Session **PS10** **Power Systems Simulation and Analysis (1)**
EM Building, Room: Anfiteatro EM

Session Chair: **Prof. Grigorios Papagiannis, Aristotle University of Thessaloniki, Greece**

4 **Techniques of Demand-Side Management Applied to LV Consumers with Hourly Rate and Distributed Generation**

Murilo V. da Cunha, Daniel P. Bernardon, Diego B. Ramos,
Laura L. C. dos Santos, Iuri C. Figueiró,
Federal University of Santa Maria, Brazil

43 **Analytical Expression of Equivalent Transverse Magnetic Permeability for Three-core Wire Armoured Submarine Cables**

N. Viafora, M. Baù, L. M. B. Dall, C. S. Hansen, T. Ebdrup, F. F. da Silva,
Aalborg University, Aalborg, Denmark

172 **Adaptive Delta Modulation Controller for Interleaved Boost DC-DC Converters**

Farag S. Alargt, The Centre for Solar Energy Research and Studies,
Tripoli, Libya
Ahmed S. Ashur, Electronic Engineering University of Tripoli, Libya
Ahmad H. Kharaz, University of Derby, UK

341 **Efficient Contactless Power Transfer System for EVs**

M. Caruso, V. Castiglia, A. O. Di Tommaso, R. Miceli,
Università degli Studi di Palermo, Italy
F. Pellitteri, L. Schirone, Sapienza Università di Roma, Rome, Italy

379 **Optimal Placement and Capacity of Distributed Generators in Medium Voltage Generic UK Network**

Nur Azwani Mohd Khairuddin, Liana M. Cipcigan, Cardiff University, UK

404 **Exponential Smoothing for Emergency Service Forecasting in Electric Power Distribution Utilities**

Iochane Garcia Guimarães, Vinícius Jacques Garcia, Daniel Pinheiro
Bernardon, Federal University of Santa Maria, Brazil
Julio Schenato Fonini, AES Sul - Power Utility, Brazil

Wednesday, 07 September 2016

09:00 - 10:30 Parallel Paper Sessions PS11–PS15

Session PS11 **High Voltage Engineering**
DEE, Room: Anfiteatro Américo Pinto

Session Chair: Prof. Manu Haddad, Cardiff University, UK

48 **Experimental Investigation of Positive DC Corona on Conductor Bundles**
E. I. Bousiou, P. N. Mikropoulos, V. N. Zagkanas,
High Voltage Laboratory, School of Electrical & Computer Engineering,
Faculty of Engineering, Aristotle University of Thessaloniki, Greece

136 **Investigation on DC Conductivity of Elastomeric Insulating Materials Considering and Reducing Influences Caused by DC Test Voltage Generation**
Claudius Freye, Christoph Felix Niedik, Frank Jenau,
Institute of High Voltage Engineering, TU Dortmund University,
Dortmund, Germany

234 **Deposited By-Products of CF₃I-CO₂ Gas Mixtures during Lightning Impulse Flashover**
Phillip Widger, L. Chen, A. Manu Haddad, Cardiff University UK

253 **Repeatability Study for a Conductivity Measurement Setup using Different Types of XLPE**
Christoph Felix Niedik, Claudius Freye, Frank Jenau
Institute of High Voltage Engineering, TU Dortmund University,
Dortmund, Germany

312 **Investigation on Surface Properties of Silicone Rubber Samples with Nanofillers**
M. Albano, A. Haddad, Cardiff University, UK
S. Venuturumilli, University of Bath, UK
H. Griffiths, N. Harid, The Petroleum Institute, UAE
R. Sarathi, IIT Madras, India

316 **Laboratory Measurement of the DC Electrical Resistivity of Wet Sand**
Zacharias G. Datsios, Pantelis N. Mikropoulos, Ioannis Karakousis
High Voltage Laboratory, School of Electrical & Computer Engineering,
Faculty of Engineering, Aristotle University of Thessaloniki, Greece

Wednesday, 07 September 2016

09:00 - 10:30 Parallel Paper Sessions PS11–PS15

Session **PS12** **Electric Vehicles and Transport (1)**
DEE, Room: Anfiteatro A2

Session Chair: Dr. Yuriy Vagapov, Glyndwr University, UK

110 **EV Charging Scheduler for Overloading Prevention
of a Distribution Transformer Supplying a Factory**

R. Godina, E. M. G. Rodrigues, J. C. O. Matias, J. P. S. Catalão,
INESC TEC and FEUP, Porto, C-MAST/UBI, Covilhã,
and INESC-ID/IST-UL, Lisbon, Portugal

114 **Integrating the PEVs' Traffic Pattern in Parking Lots
and Charging Stations in Micro Multi-Energy Systems**

Nilufar Neyestani, M. Yazdani Damavandi, R. Godina, J. P. S. Catalão,
INESC TEC and FEUP, Porto, C-MAST/UBI, Covilhã,
and INESC-ID/IST-UL, Lisbon, Portugal

162 **Development and Modelling of a Lab Scaled PEM Fuel Cell
Drive System for City Driving Application**

Wei Wu, Julius Partridge, Richard Bucknall, Faculty of Engineering
University College London, UK

240 **Design of Self-Tuning PID Controller Parameters using Fuzzy
Logic Controller for Quad-Rotor Helicopter**

Amar Bousbaine, A. Bamgbose, G. Poyi, Ajay Joseph,
College of Engineering and Technology, University of Derby, UK

320 **Real-time Road Surface and Traffic Monitoring
with a Fuzzy-Neural Controlled Quad-Rotor UAV**

G. T. Poyi, Amar Bousbaine, A. K. Joseph,
College of Engineering and Technology, University of Derby, UK

411 **Analysis and Simulation of the LLC Resonant Converter
under Different Control Methods**

Valter S. Costa, M. S. Perdigão, IPC/ISEC and IT Coimbra, Portugal
A. S. Mendes, IT-Instituto de Telecomunicações, University of Coimbra,
Coimbra, Portugal
M. Alonso, University of Oviedo, Asturias, Spain

Wednesday, 07 September 2016

09:00 - 10:30 Parallel Paper Sessions PS11–PS15

Session **PS13** **Electricity Markets**
DEE, Room: E021

Session Chair: Prof. João Catalão, FEUP, Portugal

97 **Commercial Arrangement Model for a Distributed Generation Connection Considering Several Agents**

Wagner Brignol, Luciane Canha, Rodrigo de Azevedo,
Universidade Federal de Santa Maria, Brazil
Dalvir Maguerroski, Eletrosul, Brazil

152 **Analyzing the Investment Impact of Strategic Players with Market Power**

Vegard Skonseng Bjerketvedt, Martin Kristiansen, Magnus Korpaas,
Norwegian University of Science and Technology, Trondheim, Norway

154 **Medium-Term Hydropower Scheduling with Provision of Capacity Reserves and Inertia**

Jacob Koren Brekke, Martin N. Hjelmeland, Magnus Korpas,
Norwegian University of Science and Technology, Trondheim, Norway

204 **Electric Mobility – Dealing with Uncertainties During Early Market Development in Brazil**

Ronald E.H.-B de Amorim, António Carlos Marques de Araújo,
Agência Nacional de Energia Elétrica, Brazil

291 **Long Term Expansion Planning of the Brazilian Generation System using Dynamic Systems**

Mário Domingos Pires Coelho, João Tomé Saraiva,
Faculdade de Engenharia da Universidade do Porto, Portugal
Adelino J. C. Pereira, IPC/ISEC, Coimbra, Portugal

406 **Various Worldwide Types of Deregulated Electricity Markets and Their Respective Transmission Congestion Management Schemes**

Jiawei Zhao, Kwok Lun Lo, Jianfeng Lu,
University of Strathclyde Glasgow, UK

Wednesday, 07 September 2016

09:00 - 10:30 Parallel Paper Sessions PS11–PS15

Session **PS14** **Renewable Energy Systems (1)**
DEE, Room: LSEE

Session Chair: Dr. Noel Barry, Cork Institute of Technology, Ireland

54 **Geothermal Development and Forecasting for Space Heating and Electricity Generation**

Egill Benedikt Hreinsson, Department of Electrical and Computer Engineering, University of Iceland, Reykjavik, Iceland

143 **Fundamental Frequency PWM Control of IGBT Clamped Three Phase Nine Levels Inverter Topology for Photovoltaic System**

Rabiaa Mechouma, Boubekour Azoui,
LEB Laboratory, University of Batna 2, Algeria
Sabir Ouchen, LGEB, University of Biskra, Algeria

208 **Improved Variable Step Size P&O MPPT Algorithm for PV Systems**

Xavier Serrano Guerrero, José González Romero, Xavier Cárdenas Carangui, Universidad Politécnica Salesiana, Cuenca, Ecuador
Guillermo Escrivá-Escrivá, Universidad Politécnica de Valencia, Valencia, España

259 **Comparative Analysis of Solar Irradiation Field Measurements with World Databases' Data for Specific Micro-Locations**

Vladan Durković, FEE, University of Montenegro,
and University of Belgrade, Serbia
Vladan Radulović, Sreten Škuletić,
University of Montenegro, Montenegro

317 **New MPPT Solar Generation Implemented with Constant-Voltage Constant-Current DC/DC Converter**

Huaqian Wang, Lokesh Vinayagam, Hao Jiang, Zhi Qiang Cai,
Singapore Polytechnic, Singapore
Hongqun Li, Singapore PowerGrid, Singapore

322 **Applying a Multicriteria Model to Evaluate Renewable Energy Systems at Urban Scale**

Dulce Coelho, IPC/ISEC and INESC Coimbra, Portugal
Carla Oliveira, IPC/ISCAC and INESC Coimbra, Portugal
C. Antunes, A. Martins, FCT of the University of Coimbra and INESC Coimbra, Portugal

Wednesday, 07 September 2016

09:00 - 10:30 Parallel Paper Sessions PS11–PS15

Session **PS15** **Transient Analysis and EMTP Modelling**
EM Building, Room: Anfiteatro EM

Session Chair: Dr. Michael Conlon, Dublin Institute of Technology, Ireland

77 **Comparison of Bergeron and Frequency Dependent Cable Models for the Simulation of Electromagnetic Transients**

F. Faria da Silva, Aalborg University, Denmark

217 **An Equivalent Circuit Expressing Transient Potential Distribution in Earthing Mesh**

Hiroki Tanaka, Doshisha University and West Japan Railway Company
Keiji Kawahara, West Japan Railway Company, Japan
Yuichiro Hayakawa, Naoto Nagaoka, Doshisha University, Japan

228 **Transient Modeling and Sensitivity Analysis of Cable System Parameters**

Fani Barakou, A. Vertkas, P.A.A.F. Wouters, Eindhoven University of Technology, The Netherlands
L. Wu, DNV-GL Energy, The Netherlands
E.F. Steennis, DNV-GL Energy and Eindhoven University of Technology, The Netherlands

242 **Implementation of the Prime and G3-PLC Physical Layers in the EMTP-ATP**

S. Robson, A. Haddad, Cardiff University, UK
H. Griffiths, The Petroleum Institute, Abu Dhabi, UAE

287 **Sensitivity Analysis to investigate the impact Of Penetration of DFIGs Based Wind Power Plants on Transient and Small Signal Stability of Power Systems**

O. Rahat, Islamic Azad University, Ramhormoz, Iran
M. Saniei, R. Kianinezhad, Shahid Chamran University, Ahvaz, Iran

303 **Illegal Connection Location on Distribution Lines using Traveling Waves Method**

R. Cerqueira Medrado, L. Coqueiro Silva, J. Eduardo Soto Marambio, Norsul Engenharia e Consultoria, Brasil
Krystyanny da Rocha Cavalcanti, Edmilson de Lima Santos, Marcus Vinícius de Carvalho Santos, Eletrobras Distribuição Alagoas, Brasil
Fernando Augusto Moreira, Universidade Federal da Bahia, Brasil
Davi Franco Rêgo, Instituto Federal da Bahia, Brasil

Thursday, 08 September 2016

09:00 - 10:30 Parallel Paper Sessions PS16–PS20

Session **PS16** **Electrical Services for Buildings (2)**
DEE, Room: Anfiteatro Américo Pinto

Session Chair: Dr. Oğuzhan Ceylan, Istanbul Kemerburgaz University, Turkey

135 **Combating Increasing UK Population and Household Electricity Challenge with Renewable Energy**
Mussa Sheboniea, Mohamed Darwish, Brunel University London, UK
Al Janbey, LCUCK, UK

230 **Solutions for Monitoring and Analysing for Energy Consumption – Energy Management Systems**
Paulo Bandarra, M. Travassos Valdez, Adelino Pereira,
IPC/ISEC, Coimbra, Portugal

247 **Impact of Electric Vehicle Charging Systems on Low Voltage Distribution Networks**
B. Marah, Hoare Lea Consulting Engineers, London, UK
Y. R. Bhavanam, G. A. Taylor, Brunel University London, UK
A. O. Ekwue, Jacobs Engineering Inc., Croydon, UK

321 **Energy Efficiency in Municipal Facilities: Appraisal of Interior Lighting Systems**
Dulce Coelho, IPC/ISEC and INESC Coimbra, Portugal
M. Travassos Valdez, IPC/ISEC, Coimbra, Portugal
Carla Oliveira, IPC/ISCAC and INESC Coimbra, Portugal

363 **Fraud Detection in Low Voltage Electricity Consumers using Socioeconomic Indicators and Billing Profile in Smart Grids**
Jonatas Pulz, R. Bergonsi Muller, Fabio Romero, T. Milagres Miranda,
Daimon Engineering and Systems, Brazil
Alvaro de Freitas Garcez Neto, Energy Company of South Sergipe, Brazil

380 **Study of Thermo-chromic VO₂ Material as Thermal Switches for Powerlines**
George Kiriakidis, Manolis Gagaoudakis, Physics Department, University of Crete and IESL, FORTH, Crete, Greece
Elias Aperathitis, Vasilis Binas, IESL, FORTH, Crete, Greece
Emmanouel Koudoumas, Kiriako Siderakis, Electrical Engineering Department, School of Applied Technology, TEI Crete, Greece

Thursday, 08 September 2016

09:00 - 10:30 Parallel Paper Sessions PS16–PS20

Session **PS17** **Condition Monitoring and Diagnostics**
DEE, Room: Anfiteatro A2

Session Chair: Dr. Nouredine Harid, Petroleum Institute, Abu Dhabi

205 **Comparison of IEC 60599 Gas Ratios and an Integrated Fuzzy-Evidential Reasoning Approach in Fault Identification using Dissolved Gas Analysis**

G. K. Irungu, A. O. Akumu, J. L. Munda, Tshwane University of Technology, Republic of South Africa

256 **Comparative Investigation on Pulse Shape Parameters of Partial Discharges in Air Under AC and DC Voltage Stress**

Ulrich Lühring, Daniel Wienold, Frank Jenau, Institute of High Voltage Engineering, TU Dortmund University, Dortmund, Germany

324 **Monitoring the Stator Winding Insulation Condition of a large Synchronous Motor**

Philip J. Berry, SABIC UK Petrochemicals Ltd., UK
Essam S. Hamdi, Teesside University, Middlesbrough, UK

372 **Health index Assessment for Power Transformers with Thermal Upgraded Paper up to 230 kV using Fuzzy Inference Systems**

R. D. Medina, J. P. Lata, D. P. Chacón, J. P. Bermeo, Universidad Politécnica Salesiana, Cuenca, Ecuador
D. X. Morales, Université Grenoble Alpes, France
A. E. Medina, Ulm University, Germany

382 **Partial Discharge Behavior under HVDC Superimposed with Transients**

M. Azizian Fard, A. J. Reid, D. M. Hepburn, M. Emad Farrag, Glasgow Caledonian University, UK

407 **Enhanced Condition Monitoring of Power Transformers through Improvement in Accuracy of DGA Interpretation**

Ehnaish Aburaghiega, Mohamed Emad Farrag, Donald M. Hepburn, Glasgow Caledonian University, UK

Belen Garcia, Universidad Carlos III de Madrid, Spain

Thursday, 08 September 2016

09:00 - 10:30 Parallel Paper Sessions PS16–PS20

Session **PS18** **Electric Vehicles and Transport (2)**
DEE, Room: E021

Session Chair: Prof. Naoto Nagaoka, Doshisha University, Japan

115 **Weekend Charging Impact of EVs on a Residential Distribution Transformer in a Portuguese Island**

R. Godina, E.M.G. Rodrigues, J.C.O. Matias, J.P.S. Catalão
INESC TEC and FEUP, Porto, C-MAST/UBI, Covilhã
and INESC-ID/IST-UL, Lisbon, Portugal

150 **Analysis and Comparison of Voltage Dependent Charging Strategies for Single-Phase Electric Vehicles in an Unbalanced Danish Distribution Grid**

Jorge Nájera Álvarez, Katarina Knezović, Mattia Marinelli
DTU - Technical University of Denmark

158 **Grid Frequency Support by Single-Phase Electric Vehicles: Fast Primary Control Enhanced by a Stabilizer Algorithm**

Antonio Zecchino, Michel Rezkalla, Mattia Marinelli,
DTU - Technical University of Denmark

190 **Electromagnetic Compatibility Issues of Brushless Speed Drives**

Horia Balan, Mircea Ion Buzdugan
Technical University of Cluj-Napoca, Romania

236 **Fuel Economy of a Current Hybrid London Bus and Fuel Cell Bus Application Evaluation**

Cedrick Lin, Julius Partridge, Richard Bucknall,
University College London, UK

263 **Insulation Fault Detection and Localisation in Electric and Hybrid Electric Vehicles**

Alecksey Anuchin, George Belyakov, Ksenya Fedorova,
Moscow Power Engineering Institute, Moscow, Russia
Yuriy Vagapov, Glyndwr University, Wrexham, UK

Thursday, 08 September 2016

09:00 - 10:30 Parallel Paper Sessions PS16–PS20

Session **PS19** **Power Systems Operations and Control (2)**
DEE, Room: LSEE

Session Chair: Dr. Michael Conlon, Dublin Institute of Technology, Ireland

47 **A Daily Multiobjective Optimization Model in Smart Grids**
F. Daylak, Oğuzhan Ceylan, Istanbul Kemerburgaz University, Turkey
Canan Zobi Karatekin, Istanbul Technical University, Turkey

55 **Environmental Considerations and Transmission Planning
in a Renewable Power System**
Egill Benedikt Hreinsson, Department of Electrical and Computer
Engineering, University of Iceland, Reykjavik, Iceland

72 **Dynamic Line Rating - Technologies and Challenges
of PMU on Overhead Lines: A Survey**
David L. Alvarez and Javier A. Rosero, Facultad de Ingeniería
Universidad Nacional de Colombia Bogotá, Colombia
F. Faria da Silva, Claus Leth Bak, Aalborg University, Aalborg, Denmark
Enrique E. Mombello, Universidad Nacional de San Juan, Argentina

109 **DEEPSO to Predict Wind Power and Electricity Market Prices
Series in the Short-Term**
J.N.D.L. Gonçalves, FEUP, Porto, Portugal
G.J. Osório, C-MAST/UBI, Covilhã, Portugal
J.M. Lujano-Rojas, UBI, Covilhã and INESC-ID/IST-UL, Lisbon, Portugal
T.D.P. Mendes, C-MAST/UBI, Covilhã, Portugal
J.P.S. Catalão, INESC TEC and FEUP, Porto, C-MAST/UBI, Covilhã and
INESC-ID/IST-UL, Lisbon, Portugal

345 **Crew Dispatch for Service Assistance in an Electricity Utility
Using Four Variations of the Ant Colony Optimization**
Paulo H. Baumann, Tiago M. Miranda, João Castilho Neto, Alden
U. Antunes, Dario Takahata, Leonardo H. T. Ferreira Neto,
Daimon Engineering & Systems, Brazil
Angelo C. L. Alves, Luisa M. Azevedo, Sergio L. P. C. Valinho,
Energy Company of Maranhão, Brazil

414 **A Study of Evolutionary based Optimal Power Flow
Techniques**
Zhida Deng, Mihai D. Rotaru, Jan K. Sykulski,
University of Southampton, UK

Thursday, 08 September 2016

09:00 - 10:30 Parallel Paper Sessions PS16–PS20

Session **PS20** **Power Quality**
EM Building, Room: Anfiteatro EM

Session Chair: Prof. Radu Porumb, University Politehnica of Bucharest, Romania

6 **Mitigation Strategies to Improve the Performance of AC Contactor Against Voltage Dips**
L. E. Weldemariam, H. J. Gärtner, V. Cuk, J. F. G. Cobben,
Eindhoven University of Technology, The Netherlands

23 **Performance and Analysis of Controlled Switching on a Transmission System**
Eoin Cowhey, ESB International, Ireland
Michael O'Donovan, Cork Institute of Technology, Ireland
Joe Connell, Cork Institute of Technology, Ireland

82 **Implication of Domestic Load and Electric Vehicles to Domestic Consumption in UK**
M. A. Shebonia, M. K. Darwish, Brunel University London, UK
Al Janbey, LCUCK, UK

83 **Detection and Classification of Power Quality Disturbances Based on Hilbert-Huang Transform and Feed Forward Neural Networks**
Saeed Alshahrani, Maysam Abbod, Gareth Taylor,
Brunel University London, UK

231 **An Online Electric Power Quality Disturbance Detection System**
Özal Yildirim, Tunceli University, Tunceli, Turkey
Belkis Erişti, Hüseyin Erişti, Mersin University, Mersin, Turkey
Sencer Ünal, Yavuz Erol, Yakup Demir, Firat University, Elazig, Turkey

323 **A Real-Time Power Quality Disturbance Detection System Based on the Wavelet Transform**
Belkis Erişti, Hüseyin Erişti, Mersin University, Mersin, Turkey
Özal Yildirim, Tunceli University, Tunceli, Turkey
Yakup Demir, Firat University, Elazig, Turkey

Thursday, 08 September 2016

11:00 - 12:30 Parallel Paper Sessions PS21–PS25

Session PS21 **Power Systems Simulation and Analysis (2)**
DEE, Room: E021

Session Chair: Prof. Dan Micu, Technical University of Cluj Napoca, Romania

-
- 34 **A Novel Recursive Procedure for Pareto Front Ranking in Multi-Objective Distribution System Optimization**
Gianfranco Chicco, Andrea Mazza, Angela Russo,
Politecnico di Torino, Italy
-
- 42 **Steady State Modelling of Three-core Wire Armoured Submarine Cables: Power Losses and Ampacity Estimation based on FEM and IEC**
Matteo Baù, Nicola Viafora, Chris Skovgaard Hansen, Laurids Martedal Bergholdt Dall, Thomas Ebdrup, Filipe Faria da Silva,
Aalborg University, Denmark
-
- 146 **The Electricity Infrastructure in Sri Lanka Then, Now and Hereafter**
C. Süheyl Özveren, Abertay University, Dundee, UK
Wattala Fernando, Edinburgh Napier University, Merchiston Campus, UK
-
- 214 **A Procedure for Detailed Assessment of Ground Fault-Current Distribution in Transmission Networks**
M. Coppo, R. Turri, University of Padova, Italy
H. Griffiths, N. Harid, Petroleum Institute, Abu Dhabi, UAE
A. Haddad, Cardiff University, Cardiff, UK
-
- 251 **A Multi-Objective Model for the Expansion Planning of Future Power Generation Structures**
Baris Özalay, E-Bridge Consulting, Germany
Christoph Müller, Armin Schnettler,
Institute for High Voltage Technology, RWTH, Aachen, Germany
-
- 262 **Simulation and Analysis of Switched Reluctance Generator for Renewable Energy Applications**
Simone Sartori, Andrea Tortella, University of Padova, Italy
Malabika Basu, Michael Farrell, Dublin Institute of Technology, Ireland
-

Thursday, 08 September 2016

11:00 - 12:30 Parallel Paper Sessions PS21–PS25

Session **PS22** **Renewable Energy Systems (2)**
DEE, Room: Anfiteatro A2

Session Chair: Prof. Radu Porumb, University Politehnica of Bucharest, Romania

85 **Optimal Size of Photovoltaic Systems with Storage for Office and Residential Loads in the Italian Net-Billing Scheme**

Alessandro Ciocia, Jawad Ahmad, Gianfranco Chicco, Paolo Di Leo, Filippo Spertino, Energy Department, Politecnico di Torino, Italy

209 **Utilities Investments into Residential Properties: PV Solar System with Energy Storage**

Mohamad Nassereddine, A. Hellany, M. Nagrial, J. Rizk, School of Computing, Engineering & Mathematics, Western Sydney University, Penrith, Australia

244 **Assessment of the Potential of Electrical Heating to Provide Decarbonisation**

William D. Kerr, David M. Lavery, Robert J. Best, Queen's University Belfast, UK

261 **Simulation of Automatic Network Reconfiguration Technology in Distribution System by OpenDss**

Zhenghui Zhao, Joseph Mutale, University of Manchester, UK

332 **Best Compromise of Net Power Gain in a Cooled Photovoltaic System**

Antonio D'Angola, Renato Zaffina, Scuola di Ingegneria, Università della Basilicata, Potenza, Italy

Diana Enescu, Valahia University of Targoviste, Dambovita, Romania
Paolo Di Leo, Giovanni Vincenzo Fracastoro, Filippo Spertino, Energy Department, Politecnico di Torino, Torino, Italy

400 **Solar Photovoltaic Integration on Locomotive Roof Top for South African Railway Industry**

M.J. Lencwe, Transnet Freight Rail, Railway Technology and Development Centre, Pretoria, South Africa

S.P. Chowdhury, Electrical Engineering Department, Tshwane University of Technology, Pretoria, South Africa

H.M. ElGohary, Petroleum and Mining Engineering, Suez University, Suez, Egypt

Thursday, 08 September 2016

11:00 - 12:30 Parallel Paper Sessions PS21–PS25

Session **PS23** **Smart Grids (1)**
DEE, Room: Anfiteatro Américo Pinto

Session Chair: Prof. Moofik Al-Tai, Staffordshire University, UK

159 **DISCERN Project - Enhanced Economic Evaluation of Smart Grid Use Cases**

Alan Birch, DNV GL, UK
Daniel Grote, Katrin Spanka, DNV GL, Germany

197 **The Pan-European Reference Grid Developed in ELECTRA for Deriving Innovative Observability Concepts in the Web-of-Cells Framework**

Mattia Marinelli, Michael Pertl, Michel Rezkalla,
DTU - Technical University of Denmark
Michal Kosmecki, Institute of Power Engineering, Gdańsk, Poland
Silvia Canevese, Ricerca sul Sistema Energetico - RSE, Milano, Italy
Artjoms Obushevs, Smart Grid Research Centre, Riga, Latvia
Andrei Morch, SINTEF Energy Research, Trondheim, Norway

211 **A Review of Design Criteria for Low Voltage DC Distribution Stability**

Kyle Smith, Stuart Galloway, Graeme Burt,
University of Strathclyde, Glasgow, UK

257 **Comparative Study between Direct Load Control and Fuzzy Logic Control Based Demand Response**

Chittesh Veni Chandran, Malabika Basu, Keith Sunderland,
Dublin Institute of Technology, Ireland

333 **The Role of Microgrids on Decoupling Sharp Fluctuations of Electricity Demand in Centralized Power System**

Paxis M. J. Roque, S.P. Chowdhury, Z. Huan,
Tshwane University of Technology, Pretoria, South Africa

410 **Analysis of Voltage Profile to determine Energy Demand using Monte Carlo Algorithms and Markov Chains (MCMC)**

Edwin M. García, Alexander Águila, Universidad Politécnica Salesiana,
Cuenca, Ecuador
Idi Issac, Jorge W. González, Gabriel López, Universidad Pontificia
Bolívariana, Colombia

Thursday, 08 September 2016

11:00 - 12:30 Parallel Paper Sessions PS21–PS25

Session PS24 **Integration of Renewable Sources (2)**
DEE, Room: LSEE

Session Chair: Dr. Alecksey Anuchin, Moscow Power Engineering Institute, Russia

13

A Design Scheme of Control/Optimization System for Hybrid Solar – Wind and Battery Energy Storages System

Ranjit Singh Sarban Singh, Maysam Abbod, Wamadeva Balachandran, Brunel University London, UK

79

Influence of Wind Power Ramp Rates in Short-Time Wind Power Forecast Error for Highly Aggregated Capacity

S. Martín Martínez, A. Honrubia Escribano, M. Cañas Carretón, E. Gómez Lázaro, Universidad de Castilla-La Mancha, Albacete, Spain
João P. S. Catalão, INESC TEC and FEUP, Porto, C-MAST/UBI, Covilhã, and INESC-ID/IST-UL, Lisbon, Portugal

95

Undesired Islanding of MV Networks sustained by LV Dispersed Generators compliant with present Grid Code Requirements

Fabio Bignucolo, Andrea Savio, Roberto Turri, University of Padova, Italy
Alberto Cerretti, Enel Distribuzione S.p.A., Italy

191

Load Frequency Control of a Multi-Area Power System with PV penetration: PI and PID Approach in presence of Time Delay

Saif Al Kalbani, Hassan Yousuf, Rashid Al Abri, Sultan Qaboos University, Muscat, Sultanate of Oman

397

Levelised Cost of Energy Analysis: A Comparison of Urban (Micro) Wind Turbines with Solar PV Systems

Keith Sunderland, Michael Conlon, Dublin Institute of Technology, Ireland
Mahinsasa Narayana, University of Moraturawa, Sri Lanka
Ghanim Putrus, Northumbria University, UK

401

Smart Energy Management System based on an Automated Distributed Load Limiting Mechanism and Multi-Power Switching Technique

P. Dongbaare, S.P. Daniel Chowdhury, T. O. Olwal, Tshwane University of Technology, South Africa
A. M. Abu-Mahfouz, Tshwane University of Technology and Meraka Institute, Council for Scientific and Industrial Research (CSIR), South Africa

Thursday, 08 September 2016

11:00 - 12:30 Parallel Paper Sessions PS21–PS25

Session PS25 **Power Systems Operations and Control (3)**
EM Building, Room: Anfiteatro EM

Session Chair: Prof. Gareth Taylor, Brunel University London, UK

-
- 51 **Coordinated Phase-Based Voltage Regulation in Active Unbalanced LV Distribution Networks**
Georgios C. Kryonidis, Eleftherios O. Kontis, Andreas I. Chrysochos, Charis S. Demoulias, Grigoris K. Papagiannis, Aristotle University of Thessaloniki, Greece
-
- 59 **Long Term Hydro Scheduling with Short Term Load Duration and Linear Transmission Constraints**
Egill Benedikt Hreinsson, Department of Electrical and Computer Engineering, University of Iceland, Reykjavik, Iceland
-
- 68 **Redispatch with Power Flow Decomposition and Power Transfer Distribution Factors Methods**
Iryna Chychykina, Christian Klabunde, Martin Wolter, Otto-von-Guericke-University Magdeburg, Germany
-
- 75 **Optimal Scheduling of Distributed Energy Storage Systems by Means of ACO Algorithm**
Riccardo Tisseur, Maurizio Fantino, ISMB Torino, Italy
Federico de Bosio, Gianfranco Chicco, Michele Pastorelli, Politecnico di Torino, Italy
-
- 88 **Parameter Estimation and Sensitivity Analysis of Distribution Network Equivalent**
A. Z. M. Shahriar Muttalib, G. A. Taylor, Brunel University London, UK
M. E. Bradley, National Grid, UK
-
- 348 **Crew Dispatch for Network Services in an Electricity Utility using Ant Colony Optimization Methodology**
Paulo H. Baumann, Tiago M. Miranda, Fábio Romero, João Castilho Neto, Alden U. Antunes, Dário Takahata, Leonardo H. T. Ferreira Neto, Daimon Engineering and Systems, São Paulo, Brazil
Ângelo C. L. Alves, Luisa M. Azevedo, Sérgio L. P. Valinho, Energy Company of Maranhão, São Luis, Brazil
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Thursday, 08 September 2016

14:00 - 15:30 Parallel Paper Sessions PS26–PS30

Session **PS26** **HVDC, FACTS and Power Electronics (2)**
DEE, Room: Anfiteatro Américo Pinto

Session Chair: Prof. Naoto Nagaoka, Doshisha University, Japan

16 **Optimized Modulation Technique with Double Switching Frequencies for STATCOM Application**
Hussain M. Bassi, King Abdulaziz University, Jeddah, Saudi Arabia

57 **Switching Performance Comparison of a Power Switch in a Cascode Configuration using a SuperJunction MOSFET**
Abraham López, Juan Rodríguez, María R. Rogina, Ignacio Castro, Alberto Rodríguez, University of Oviedo, Asturias, Spain

151 **Overvoltage Protection**
Panagiotis Dimitriadis, Mohamed Darwish, Brunel University London, UK
Christos Marouchos, Cyprus University of Technology, Limassol, Cyprus

339 **Comparison Electromagnetic Shielding Effectiveness Between Single Layer and Multilayer Shields**
Gaoui Bachir, Hadjadj Abdechafik, Kious Mecheri, Université Amar Telidji de Laghouat, Algeria

413 **Auxiliary Converter for Variable Inductor Control in a DC-DC Converter Application**
Mebrahtom Beraki, IPC/ISEC, Coimbra, Portugal
Marina Perdigao, IPC/ISEC and IT Coimbra, Portugal
Felipe Machado, Altran Portugal and INESC Coimbra, Portugal
João P. Trovão, e-TESS Laboratory, University of Sherbrooke, Canada

Thursday, 08 September 2016

14:00 - 15:30 Parallel Paper Sessions PS26–PS30

Session **PS27** **Power Systems Simulation and Analysis (3)**
DEE, Room: Anfiteatro A2

Session Chair: Prof. Dan Micu, Technical University of Cluj Napoca, Romania

49 **Modeling of Nonlinear Dynamic Power System Loads using the Vector Fitting Technique**

Eleftherios O. Kontis, Andreas I. Chrysochos, Grigoris K. Papagiannis, Aristotle University of Thessaloniki, Greece
Theofilos A. Papadopoulos, Democritus University of Thrace, Xanthi, Greece

139 **A Modified Binary Fruit Fly Optimization Algorithm Based on Covering Strategy for Optimal PMUs Placement**

Ragab A. El-Sehiemy, Kafrelsheikh University, Egypt
Rizk M. Rizk-Allah, University of Minoufia, Shebin El-Kom, Egypt

189 **Computer-Based Analysis of an Urban 20 kV Medium-Voltage Network**

Mike Alexander Lagler, Thomas Wieland, Ernst Schmutzner, Graz University of Technology, Graz, Austria

250 **Analysis of Alternative Transition Paths for the German Energy System**

Christoph Müller, Stephan Raths, Simon Koopmann, Armin Schnettler, Institute for High Voltage Technology, RWTH Aachen, Germany

315 **Load Flow and Short-Circuit Analysis in a Romanian 110/20 kV Retrofitted Substation**

Levente Czumbil, Dan D. Micu, Stefan F. Braicu, Denisa Stet, Technical University of Cluj-Napoca, Romania
Alexis Polycarpou, Frederick University, Cyprus

405 **Power Flow in Radial Systems using a Topology based on Geo Referential Approach**

Adrian R. Criollo, D. X. Morales, Ricardo D. Medina, F. Quizhpi, Universidad Politecnica Salesiana, Cuenca, Ecuador

Thursday, 08 September 2016

14:00 - 15:30 Parallel Paper Sessions PS26–PS30

Session **PS28** **Smart Grids (2)**
DEE, Room: E021

Session Chair: Prof. Ghanim Putrus, University of Northumbria, UK

271 **Impacts of Conservation Voltage Reduction on Customer Power Quality in Future Networks**

Gareth McLorn, D. John Morrow, Seán McLoone, Robert Best, Xueqin Liu, David Laverty, Queen's University Belfast, UK

272 **Procedures for Day-ahead Operation Planning of Heat and Power Supplying Smart Grid**

B. Aluisio, A. Cagnano, E. De Tuglie, M. Dicorato, G. Forte, M. Trovato, DEI, Politecnico di Bari, Italy

301 **AC Voltage Normalization – Conception and Technology for Smart Grid System**

Alexander G. Fishov, Irina L. Klavsuts, Dmitry A. Klavsuts, Marina V. Khayrullina, Novosibirsk State Technical University, Novosibirsk, Russia

302 **The Development of Simulation Model of Innovative Technology of AC Voltage Normalization for Introduction into Smart Grid System**

Irina L. Klavsuts, Anastasia G. Rusina, Dmitry A. Klavsuts, Novosibirsk State Technical University, Novosibirsk, Russia

342 **Reduction of Topological Connectivity Information in Electric Power Grids**

Alexander Prostejovsky, Oliver Gehrke, Mattia Marinelli, DTU - Technical University of Denmark, Risø, Denmark
Mathias Uslar, OFFIS, Institute for Information Technology, Oldenburg, Germany

370 **Downsizing the Battery Capacity Requirement of Photovoltaic/Hydrogen Systems by Adjusting the Asymmetric Time Series Using Improved Prediction Based Power Management Strategy**

Nguyen Thi Hoai Thu, Nakayama Tomonori, Ishida Masayoshi, University of Tsukuba, Japan

Thursday, 08 September 2016

14:00 - 15:30 Parallel Paper Sessions PS26–PS30

Session **PS29** **Protection Systems (2)**
DEE, Room: LSEE

Session Chair: Dr. Hassan Nouri, University of West England, UK

41 **Kalman Filter Application to Symmetrical Fault Detection during Power Swing**

J. Khodaparast, M. Khederzadeh, Shahid Beheshti University, Iran
F. Faria da Silva, C. Leth Bak, Aalborg University, Denmark

173 **Assessment of the Behavior of Protection Systems in Radial Networks with Distributed Generation**

P. I. Santos e Abreu, A. Gomes Martins,
FCTUC, Universidade de Coimbra, Portugal

252 **Protection, Automation and Control Systems and the IEC 61850 Paradigm – New Testing and Maintenance Challenges**

Rafaela Correia, IPC/ISEC, Coimbra, Portugal
Luis Candeias, Rui Francisco, EDP Distribuição - Energia, SA, Portugal
C. Machado Ferreira, IPC/ISEC and INESC Coimbra, Portugal
Fernando Lopes, IPC/ISEC and IT Coimbra, Portugal

329 **The Role of Global Earthing Systems to Ensure the Reliability of Electrical Networks**

Thomas Mallits, Ernst Schmutzner, Lothar Fickert, Thomas Höhn,
Elisabeth Hufnagl, University of Technology, Institute of Electrical
Power Systems, Graz, Austria

418 **Analysis of the Effects of Asymmetrical Power Swing on Distance Protection**

S. M. Hashemi, M. Sanaye-Pasand, University of Tehran, Iran

424 **Impulsive Grounding Systems Embedded in Concrete: Theoretical and Practical Experiments**

Alex B. Tronchoni, Daniel S. Gazzana, Guilherme A. D. Dias,
Roberto C. Leborgne, UFRGS University, Brazil
Arturo S. Bretas, University of Florida, USA
Marcos Telló, State Company of Electrical Energy, Brazil

Thursday, 08 September 2016

14:00 - 15:30 Parallel Paper Sessions PS26–PS30

Session **PS30** **Power Engineering Education (2)**
EM Building, Room: Anfiteatro EM

Session Chair: Dr. Essam Hamdi, Teesside University, UK

9 **Development of Telelab and Integration of Wind Turbine System into Hybrid Power System**

Pankaj Kolhe, Berthold Bitzer, South Westphalia University of Applied Sciences, Soest, Germany

50 **A Performance Comparison Between Extended Kalman Filter and Unscented Kalman Filter in Power System Dynamic State Estimation**

Hesam Khazraj, F. Faria da Silva, Claus Leth Bak, Aalborg University, Aalborg, Denmark

216 **3D Virtual Laboratory for Teaching Circuit Theory: A Virtual Learning Environment (VLE)**

M. Travassos Valdez, IPC/ISEC, Coimbra Portugal
C. Machado Ferreira, IPC/ISEC and INESC Coimbra, Portugal
F. Maciel Barbosa, Faculdade de Engenharia da Universidade do Porto and INESC TEC, Porto, Portugal

225 **An educational approach to a Lighting Design Simulation using DIALux evo Software**

A. F. C. Vizeu da Silva, A. Oliveira Godinho, C. I. Faustino Agreira, M. Travassos Valdez, IPC/ISEC, Coimbra, Portugal

268 **Integrating Low Cost Platforms on Electrical Power Systems for Control and Condition Monitoring**

Francisco Brito, Inácio Fonseca, José Torres Farinha, IPC/ISEC, Coimbra, Portugal
F. Maciel Barbosa, Faculdade de Engenharia da Universidade do Porto and INESC TEC, Porto, Portugal

421 **Low-cost Photovoltaic Emulator for Instructional Laboratories**

Yuriy Vagapov, Glyndwr University, Wrexham, UK
Aleckey Anuchin, Moscow Power Engineering Institute, Moscow, Russia

Friday, 09 September 2016

09:00 - 10:30 Parallel Paper Sessions PS31–PS35

Session **PS31** **Power Systems Simulation and Analysis (4)**
DEE, Room: Anfiteatro Américo Pinto

Session Chair: Dr. Yuriy Vagapov, Glyndwr University, UK

76 **Development of Space Vector Modulation Control Schemes for Grid Connected Variable Speed Permanent Magnet Synchronous Generator Wind Turbines**

Ahmed S. Al-Toma, Gareth A. Taylor, Maysam Abbod,
Brunel University London, UK

89 **The Role of Load Models and Reactive Power Support During Large Frequency Transients**

Daniele Macalli, V. Ilea, G. Giannuzzi, A. Berizzi,
Politecnico di Milano, Milan, Italy
R. Zaottini, Terna SpA, Italy

153 **Risk-based Asset Management in the Electricity Distribution Network – A Case Study for Critical Telecommunications Equipment**

Rui Francisco, EDP Distribuição, Portugal
Tânia Crespo, IPC/ISEC, Coimbra, Portugal
Fernando Lopes, IPC/ISEC and IT Coimbra, Portugal
C. M. Machado Ferreira, IPC/ISEC and INESC Coimbra, Portugal

226 **A Bi-layer Optimization Based Scheduling Strategy for Wind Power and Electrical Vehicles Considering Participation of Aggregators**

Ziqi Zhang, Jun Yang, Wuhan University, P. R. China

284 **Developing a Wind and Solar Power Data Model for Europe with High Spatial-Temporal Resolution**

Ingeborg Graabak, Magnus Korpås, NTNU, Norway
Harald Svendsen, SINTEF, Norway

310 **Application of Signal Processing Techniques for the Generation of Wind Profiles Dedicated to Electrical System Planning Tools**

Benjamin Picart, Bernard Gosselin, Martin Hupez, Zacharie De Grève,
François Vallée, Faculté Polytechnique, University of Mons, Belgium

Friday, 09 September 2016

09:00 - 10:30 Parallel Paper Sessions PS31–PS35

Session **PS32** **Integration of Renewable Sources (3)**
DEE, Room: Anfiteatro A2

Session Chair: Prof. Ghanim Putrus, University of Northumbria, UK

100

Influence of DFIG based Wind Generation on Small Signal Stability

A. Rainer, Herwig Renner, Graz University of Technology, Austria
Michael Pertl, Mattia Marinelli, DTU – Technical University of Denmark

113

Characterization of Biomass Woodchips as Fuel for Industrial Boilers

L.J.R. Nunes, J.C.O. Matias, DEGEIT, University of Aveiro and C-MAST/UBI, Covilhã, Portugal
João P. S. Catalão, INESC TEC and FEUP, Porto, C-MAST/UBI, Covilhã, and INESC-ID/IST-UL, Lisbon, Portugal

274

Intelligence Based Coordination of Large Scale Grid-Connected Photovoltaic Systems

Akbar Swandaru, Mihai D. Rotaru, Jan K. Sykulski, University of Southampton, UK

281

Optimal Sizing of Solar PV/Battery and Biogas Generators in Remote Micro Grid

Mohamad Naim Mohd Nasir, Joseph Mutale, The University of Manchester, UK

335

Flexible Power Control of Photovoltaic Plants Connected to Distribution Networks

Susana Ribeiro, ESTGV/IPV, Viseu, Portugal
Paulo Moisés Costa, Eduardo Gouveia, Daniel Albuquerque, ESTGV/CI and DETS/IPV, Viseu, Portugal
Pedro Sousa, Martifer Solar, Portugal

398

Sizing and Techno-Economic Analysis of a Grid Connected Photovoltaic System with Hybrid Storage

Fayçal Bensmaine, Dhaker Abbes, Benoit Robyns, L2EP, Ecole des Hautes Etudes d'Ingénieur, Lille, France
Antoine LABRUNIE, GB SOLAR, Paris, France

Friday, 09 September 2016

09:00 - 10:30 Parallel Paper Sessions PS31–PS35

Session **PS33** **HVDC, FACTS and Power Electronics (3)**
DEE, Room: E021

Session Chair: Dr. Mohamed E. Farrag, Glasgow Caledonian University, UK

44 **A Novel Multi-Inputs-Single-Output DC Transformer Topology**

M. Alzgoool, H. Nouri, C. Toomer, University of the West of England,
UWE Bristol, UK

G. Alzghoul, Jordainian Armed Forces, Jordan

330 **A New DC-DC Converter Based On Quasi Switched Boost
Topology With CCM and DCM Operation**

Amit Kumar, Ajit Singh, Ravindra Kumar Singh, Motilal Nehru National
Institute of Technology Allahabad, India

344 **Interconnection of Offshore Wind Farms using Variable
Frequency in Offshore AC Grids**

Dimitra-Chrysie I. Sortsi, Spyros I. Gkavanoudis, Charis S. Demoulias,
Aristotle University of Thessaloniki, Greece

374 **A Novel Low Voltage Grid Protection Component for Future
Smart Grids**

Wolfgang Hauer, Michael Bartonek, Eaton Industries GmbH, Austria

423 **Investigation of the switched Inductor Circuit for Harmonics
Compensation**

Christos Marouchos, Eftihia Josif, Cyprus University of Technology,
Limassol, Cyprus

Mohamed Darwish, Brunel University London, UK

Friday, 09 September 2016

09:00 - 10:30 Parallel Paper Sessions PS31–PS35

Session **PS34** **Power Systems Operations and Control (4)**
DEE, Room: LSEE

Session Chair: Dr. Hassan Nouri, University of West England, UK

32 **Design and Calculation of Neutral Grounding Resistance in 66 kV Libyan Network and its Effects**
Hasan Z. Al-Amari, Ministry of Electricity and Renewable Energy, Libya
Wadha Aldwik, General Electric Company of Libya

156 **STATCOM to Improve the Voltage Stability of an Electric Power System with High Penetration of Wind Generation**
R. Monteiro Pereira, Adelino J. C. Pereira, IPC/ISEC, Coimbra, Portugal
C. Machado Ferreira, IPC/ISEC and INESC Coimbra, Portugal
F. Maciel Barbosa, FEUP and INESC TEC, Porto, Portugal

157 **Comparison of the Influence Factor and Horizontal Network Methods for Evaluate the Influence of the External Elements on the Transmission System Operator's Responsibility Area**
P. I. Santos e Abreu, FCTUC, Universidade de Coimbra, Portugal
Rui Pestana, REN – Redes Energéticas Nacionais, Lisboa, Portugal
C. Machado Ferreira, IPC/ISEC and INESC Coimbra, Portugal
F. Maciel Barbosa, FEUP and INESC TEC, Porto, Portugal

229 **Probabilistic Security-Constrained Optimal Power Flow by Formulation of a Stochastic Power Flow Response Surface**
Lalitha Subramanian, Aniruddha Bhattacharya,
National Institute of Technology, Agartala, India

286 **Control Variable Selection for the Corrective Control of Voltages and Reactive Power Flows**
Frano Tomašević, Ivica Pavić, Marko Delimar,
University of Zagreb, Croatia

328 **Generating Synthetic Electric Power System Data with Accurate Electric Topology and Parameters**
Zhifang Wang, Seyyed Hamid Elyas,
Virginia Commonwealth University, Richmond VA, USA
Robert J. Thomas, Cornell University Ithaca, NY, USA

Friday, 09 September 2016

09:00 - 10:30 Parallel Paper Sessions PS31–PS35

Session **PS35** **Power Engineering Education (3)**
EM Building, Room: Anfiteatro EM

Session Chair: Prof. Fernando Lopes, IPC/ISEC, Portugal

270

**Systems for Micro Generation and Energy Storage,
State of the Art – Example of the Piezoelectric Effect**

Ana Ramos, André Pinto, IPC/ISEC, Coimbra, Portugal
Inácio Fonseca, IPC/ISEC and CEMUC, Coimbra, Portugal
C. M. Machado Ferreira, IPC/ISEC and INESC Coimbra, Portugal

297

**An Educational Platform for Residential and Industrial
Energy Monitoring**

Fábio Carraco, Gonçalo Santos, IPC/ISEC, Coimbra, Portugal
Inácio Fonseca, IPC/ISEC and CEMUC, Coimbra, Portugal
Fernando Lopes, IPC/ISEC and IT Coimbra, Portugal

353

Hydroelectric Power Plant Simulator for Operator Training

Edison A. C. Aranha Neto, Pedro Henrique Schulze,
Fabrício Y. K. Takigawa, Rubiapiara C. Fernandes,
Federal Institute of Santa Catarina, Brazil
Renata Manicardi, Statkraft ENEX, Brazil

395

**Ratings of Technical Universities of the World
Problems and Forecasts**

Suleyman V. Levinzon, Baumann Moscow State University,
Darmstadt, Germany
Natalia V. Tsarkova, Baumann Moscow State University. Kaluga, Russia

402

**A Parallel Hurricane Optimization Algorithm for Emission
Economic Load Dispatch Problem**

Rizk M. Rizk-Allah, University of Minoufia, Shebin El-Kom, Egypt
Ragab El-Sehiemy, Faculty of Engineering, Kafrelsheikh university, Egypt

403

**Ethics and Civic Education in the Curriculum of Portuguese
Power Engineering Courses**

Fátima Monteiro, IPC/ISEC, Coimbra, Portugal
Carlinda Leite, Cristina Rocha, Faculdade de Psicologia e de Ciências
da Educação da Universidade do Porto, Portugal

Technical Programme Summary

ID	Session Topic	Room
Tuesday, 06 September 2016, 14:00 - 15:30		
PS1	Power Systems Operations and Control (1)	DEE, Anfiteatro Américo Pinto
PS2	Electrical Services for Buildings (1)	DEE, Anfiteatro A2
PS3	ICT for Future Electricity Grids	DEE, E021
PS4	Distributed Generation	DEE, LSEE
PS5	HVDC, FACTS and Power Electronics (1)	EM Building, Anfiteatro
Tuesday, 06 September 2016, 16:00 - 17:30		
PS6	Protection Systems (1)	DEE, Anfiteatro Américo Pinto
PS7	Reliability Analysis	DEE, Anfiteatro A2
PS8	Integration of Renewable Sources (1)	DEE, E021
PS9	Power Engineering Education (1)	DEE, LSEE
PS10	Power Systems Simulation and Analysis (1)	EM Building, Anfiteatro
Wednesday, 07 September 2016, 09:00 - 10:30		
PS11	High Voltage Engineering	DEE, Anfiteatro Américo Pinto
PS12	Electric Vehicles and Transport (1)	DEE, Anfiteatro A2
PS13	Electricity Markets	DEE, E021
PS14	Renewable Energy Systems (1)	DEE, LSEE
PS15	Transient Analysis and EMTP Modelling	EM Building, Anfiteatro
Thursday, 08 September 2016, 09:00 - 10:30		
PS16	Electrical Services for Buildings (2)	DEE, Anfiteatro Américo Pinto
PS17	Condition Monitoring and Diagnostics	DEE, Anfiteatro A2
PS18	Electric Vehicles and Transport (2)	DEE, E021
PS19	Power Systems Operations and Control (2)	DEE, LSEE
PS20	Power Quality	EM Building, Anfiteatro
Thursday, 08 September 2016, 11:00 - 12:30		
PS21	Power Systems Simulation and Analysis (2)	DEE, E021
PS22	Renewable Energy Systems (2)	DEE, Anfiteatro A2
PS23	Smart Grids (1)	DEE, Anfiteatro Américo Pinto
PS24	Integration of Renewable Sources (2)	DEE, LSEE
PS25	Power Systems Operations and Control (3)	EM Building, Anfiteatro

Thursday, 08 September 2016, 14:00 - 15:30

PS26	HVDC, FACTS and Power Electronics (2)	DEE, Anfiteatro Américo Pinto
PS27	Power Systems Simulation and Analysis (3)	DEE, Anfiteatro A2
PS28	Smart Grids (2)	DEE, E021
PS29	Protection Systems (2)	DEE, LSEE
PS30	Power Engineering Education (2)	EM Building, Anfiteatro

Friday, 09 September 2016, 09:00 - 10:30

PS31	Power Systems Simulation and Analysis (4)	DEE, Anfiteatro Américo Pinto
PS32	Integration of Renewable Sources (3)	DEE, Anfiteatro A2
PS33	HVDC, FACTS and Power Electronics (3)	DEE, E021
PS34	Power Systems Operations and Control (4)	DEE, LSEE
PS35	Power Engineering Education (3)	EM Building, Anfiteatro