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Estimation of Energy Losses in a Wind Park

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***Abstract*— The study of energy losses in any electric installation is closely related to energy efficiency. Its calculation depends on the number and the quality of the available electrical measurements. Typically, every wind park has electrical measurements in all its wind turbines and its HV point of connection. However, it is difficult to calculate in an easy way these losses due to problems like redundancy, inaccuracy, lack of data, etc.**

A state estimation (SE) method will be proposed in this article, in order to calculate the power losses. By means of available measurements (power, voltage, current...) and parameters of the network (cables, transformers...), the losses taking place in each element can be obtained. SE also allows detecting errors in measurement and calculating the wind park state when certain measurement equipments are unavailable. Wind speed measurements are used to get pseudo-measurement if necessary and to filter errors.

Finally, an economic study will be done taking into account the different ways of selling wind energy in the Spanish network. Consequently, the economic importance of losses will be evaluated too.

The location of this project is The Sotavento Wind Park, Serra da Loba, Spain. The results shown throughout this article have been applied there with the aim of analysing its energy efficiency.

Keywords-component; wind energy, energy losses, energy efficiency, state estimation

I. INTRODUCTION

Measurements devices rarely cover all the electrical magnitudes in an installation, e.g. a wind park; that is why many electrical variables cannot be obtained directly. In this way, a study of energy efficiency starts from measurements so as to obtain the magnitudes related to efficiency. This could be done thanks to a power flow; before the remaining values could be calculated, measurements must be supposed to be correct. Nevertheless, measurements devices have specific errors related to their precision and accuracy; besides, they could be working improperly due to breakdowns or communications failures. Where measurement errors are taken into account to obtain the network state [1][2][3], a SE method can be applied to overcome these problems. From network state, losses in any network element can be calculated, so that energy efficiency for the installation can be obtained.

In the following paragraphs, it is presented a method for energy efficiency calculation in the Sotavento Experimental Wind Park [4]. In the first part there is a description of the wind park, then, the SE method is introduced, and lastly, electrical and economical results are shown.

II. SOTAVENTO EXPERIMENTAL WIND PARK

The project, called Sotavento Galicia S. A., was born in 1997 promoted by the Consellería de Industria e Comercio (Department for Industry and Trade), one of the departments of the Xunta de Galicia (local government) [4]. Its objective was to obtain not only economic, but also scientific and technical benefits. Three public institutions are taking part in this project, with a total amount of 51% of its capital.

The Sotavento Experimental Wind Park has installed 24 wind turbines with a total power of 17,56 MW and an estimated annual energy production of 38,500 MWh (see Figure 4).

There are two 20 kV underground lines where the MV side of wind turbine transformers are connected. Each line has linked 12 wind turbines. The central control building is fed from one line.

This work was produced as part of a research project and was supported by Sotavento Galicia, S.A.

The 20kV lines are connected to a 132kV/20kV substation where an auxiliary services MV/LV transformer, two capacitor banks and the main 132kV/20kV transformer are installed. Parameters of transformers, wind turbines, cables and capacitor banks are shown in Appendix.

Reactive compensation is done by means of capacitor banks installed in the LV side of wind turbines and in the substation [5].

Measurement devices for voltage, current, active power and reactive power are installed in all the wind turbines and in the substation. There is neither any measurement in the 20 kV side of the wind park, nor information about the Power Factor Corrector (PFC) installed in the substation.

Since wind speed and direction are taken into consideration, data extracted from the measurement tower (installed in the park) are used (see Figure 1).

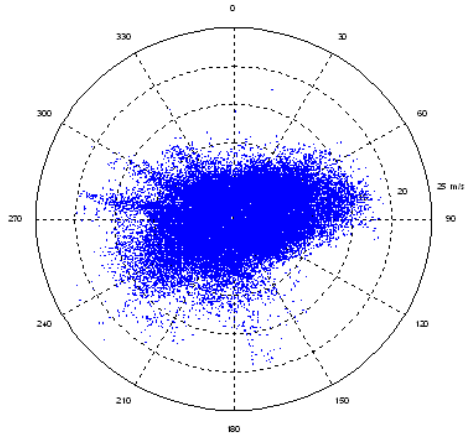


Figure 1 Wind rose

III. ESTIMATION OF ENERGY LOSSES

Electrical measurements in a network have shown some incertitude about precision and accuracy of measurement devices, communication problems, breakdowns, and so on. Hence, it could not be directly used to know the network state. As a consequence, an SE is necessary to get over these problems; it can be defined as the method to calculate the state in a network whose parameters and topology are known from redundant measurements.

The minimum number of variables that allow determining the network state are known as "state variables". Any electrical variable can be calculated from them. These state variables are the modulus and angle of nodal voltages, and from them an estimation of any electrical variable can be obtained, including those that have been measured. In that case, the value used must be the estimated one.

In SE a minimum of measurement, distributed in an appropriate way, must be known to have a topological observable network. There are 58 nodes in the Sotavento Experimental Wind Park, so, it is necessary a set of 115 measurements. At least, 57 of them must be active power measurements and another 57 must be reactive ones.

In the wind park there are 29 active and reactive power and voltage measurements; according to the previous paragraph the wind park network does not seem to be observable. However, from node 30 to 55 there is no power injection, so virtual measurements can be considered for these nodes. In the control center building (node 56) active and reactive energy are measured every 15 minutes. Thanks to these measurements mean power values can be obtained and used as pseudo-measurements.

There is not any reactive power measurement in the substation capacitor banks (nodes 57 and 58); the curves shown in Figure 2 are used with the aim of estimating their state. These curves are fitted in the gaps detected in the active and reactive power, which are injected by the wind park to the 132kV network (node 29). The values obtained are used as pseudo measurements of reactive power, also, a value zero for active power is used as virtual measurement.

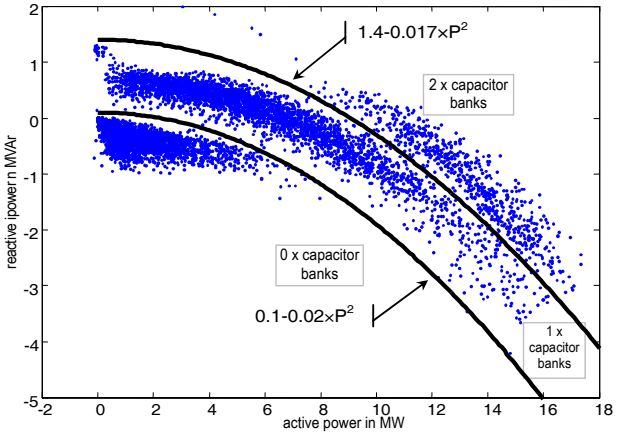


Figure 2 Active and reactive power curves used to estimate capacitor bank state

As a resume in TABLE I the available measurements for SE are shown, the total number of real, virtual and pseudo mesurements garatentees the redundancy. Furthermore, the network is topological observable because it is a radial network with more than 57 measurements of active and reactive power, and with more than one voltage measurements [6].

TABLE I REAL., PSEUDO AND VIRTUAL MEASUREMENTS

	Meas.	Pseudo Meas.	Virtual Meas.	Total
P	29	1	28	58
Q	29	3	26	58
V	29			29
				145

A variance or weight is calculated for each measurement, it represents the confidence in the measurement device, supposing that their errors follow a Gauss distribution. In the case of Sotavento Wind Park, all the measurement devices are the same; for that reason, an equal variance is assigned to all of them. In case of a non-existent measurement, they are

substituted by pseudo-measurements, which are obtained from the rest of measurements. The variance for these pseudo-measurements much be higher than than those for normal ones (e.g. ten times higher), because the associated error is higher too.

The SE method used in this paper is weighted least square method with restrictions. These restrictions are the virtual measurements, those that have associated null active and reactive powers.

IV. RESULTS

The SE has been applied over one year measurement data. Therefore, all the instantaneous electrical magnitudes related to energy efficiency have been calculated. It is by means of these results that an estimation of the yearly generation and the distribution losses can be done. As an example, in Figure 3 the estimated and measured values for active power, reactive power and voltage in wind turbine 11 are shown. Wind turbine communication was lost from 3970 hours, so, pseudo-measurements were used for SE.

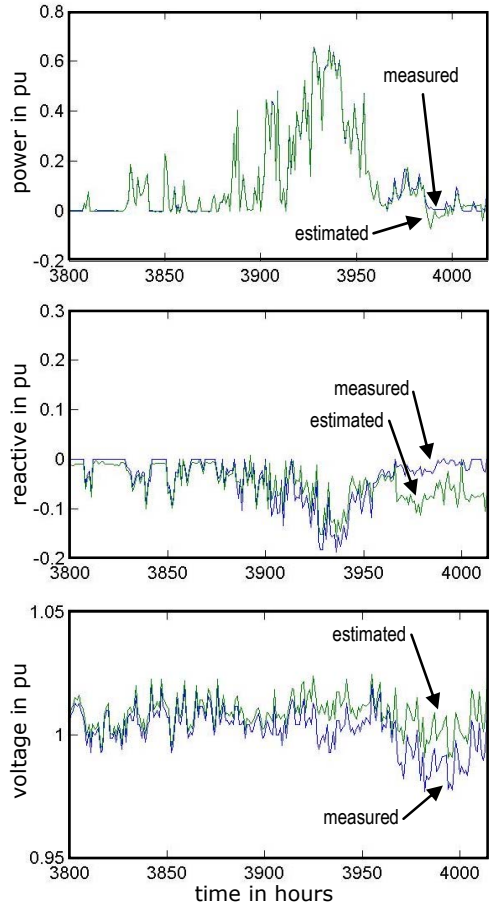


Figure 3 Estimated and measured values for active power, reactive power and voltage in wind turbine 11

Wind turbine generation is distributed between network losses, wind park consumption and power injected from substation. Energy is produced in wind turbines, one part is injected to the 132kV network and the rest is consumed or lost (see Figure 5). Reactive energy comes from capacitors banks, MV lines and 132kV network, its distribution over the wind park elements is shown in Figure 6.

V. ECONOMIC ANALISYS

In Spain, the remuneration of wind energy consists in the implementation of a regime by which each kWh generated is paid to the producer at a special price, higher than the market one [5][7][8][9].

The legal and economic status of wind power installations is currently regulated by Royal Decree (RD) 436/2004. Wind power producers have the right to choose between two options:

A) First option consists in selling the electricity to the distribution company. The owner of the installations will be entitled to receive as remuneration:

- A regulated tariff per kWh applied to all their output. This tariff consists of a percentage of the Average Electricity Tariff (AET) published every year.
- Plus a reactive power service supplement and a supplement for continuity against voltage dips.

B) The second option is to sell the electricity freely in the market. In this case the remuneration is:

- The hourly price per kWh in the electricity pool or the price freely agreed with the purchaser.
- Plus a premium per kWh that consists of a percentage of AET.
- Plus an incentive per kWh for participating in the market, it also consists in an AET percentage.
- Plus a reactive power service and continuity of the supply against voltage dips supplement.
- Plus a capacity payment.

C) Plants remaining in the previous RD2818/1998 had the option to sell the electricity at the market price with a subsidy. The subsidy had annual revisions according to the evolution of ART and annual average market price. The option might be freely exercised up to January 1, 2007.

By means of year's data and applicating the SE, the results shown in TABLE II of the efficiency for the three options depicted above can be calculated. The losses in the wind park network and the consumption in the Central Control (CC) building are presented.

TABLE II ENERGY LOSSES FOR THE DIFFERENT SELLING OPTIONS

	A) RD 2818/1998	B) Sales to distributor	C) Market Sales
Energy (M€)	2.66	2.00	2.40
Losses (k€)	78.68	59.13	71.77
% Losses	2.96	2.95	2.99
CC Building Energy (k€)	8.67	6.55	8.15
% CC Building Energy	0.33	0.33	0.34

The energy losses represent 2.96% of the energy generated by the wind parks. For options A and B, this percentage has the same value when it is calculated from energy prices. In the option C (Market Sales), the energy price depends on the market and the percentage of losses is higher. The conduct of the energy consumed by the control center building is similar.

VI. CONCLUSIONS

The main conclusions of this study are:

- Taking one year of measurement data a SE method has been used to estimate the energy efficiency of a wind park. Errors in measurements and lack of data have been overcome by using pseudo-measurements.
- Losses represent a 2.84% of the energy generated by wind turbines; consumption of CC building represents a 0.32%, and what is left: 96.8% is the energy injected to the 132 kV network.
- Capacitor banks generate a 38.1% of reactive energy consumed in the wind park, a 32.5% is generated by the MV lines, and the rest: 29.3% comes from 132kV network. The reactive power generated by MV lines is very close to those consumed in substation and wind turbine transformers. The average power factor is 0.9983.
- From an economic point of view, the cost of energy losses is between 2.95% and 2.99% of the price of the energy produced. In accordance with the CC building, the percentage of its energy consumption varies from 0.33% to 0.34 %.

ACKNOWLEDGMENT

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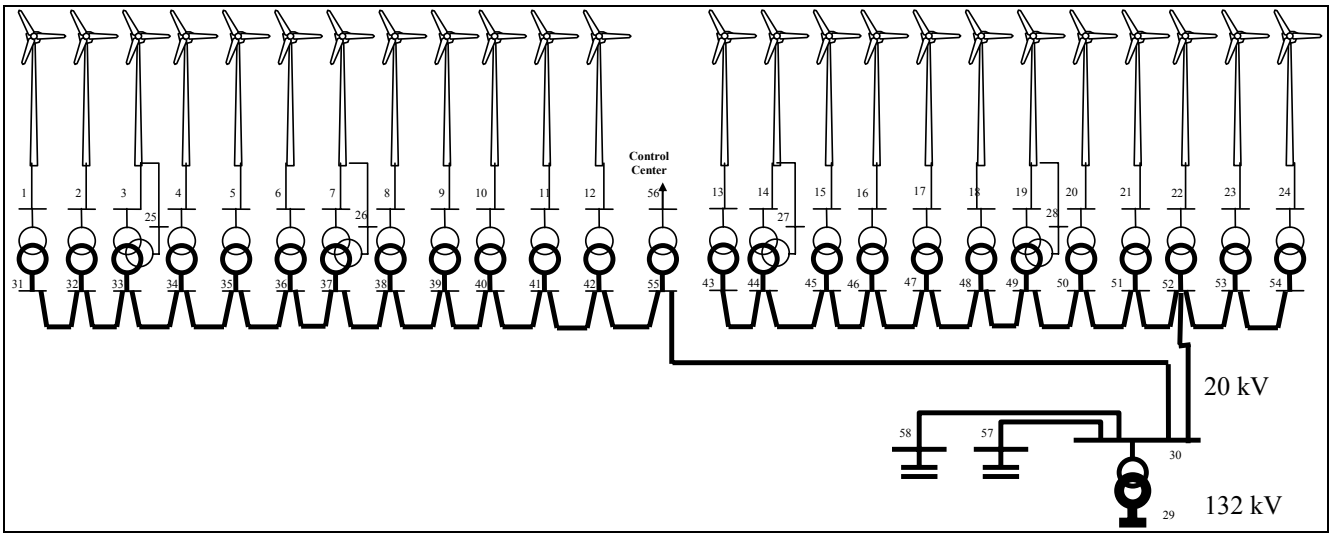


Figure 4 Wind park scheme

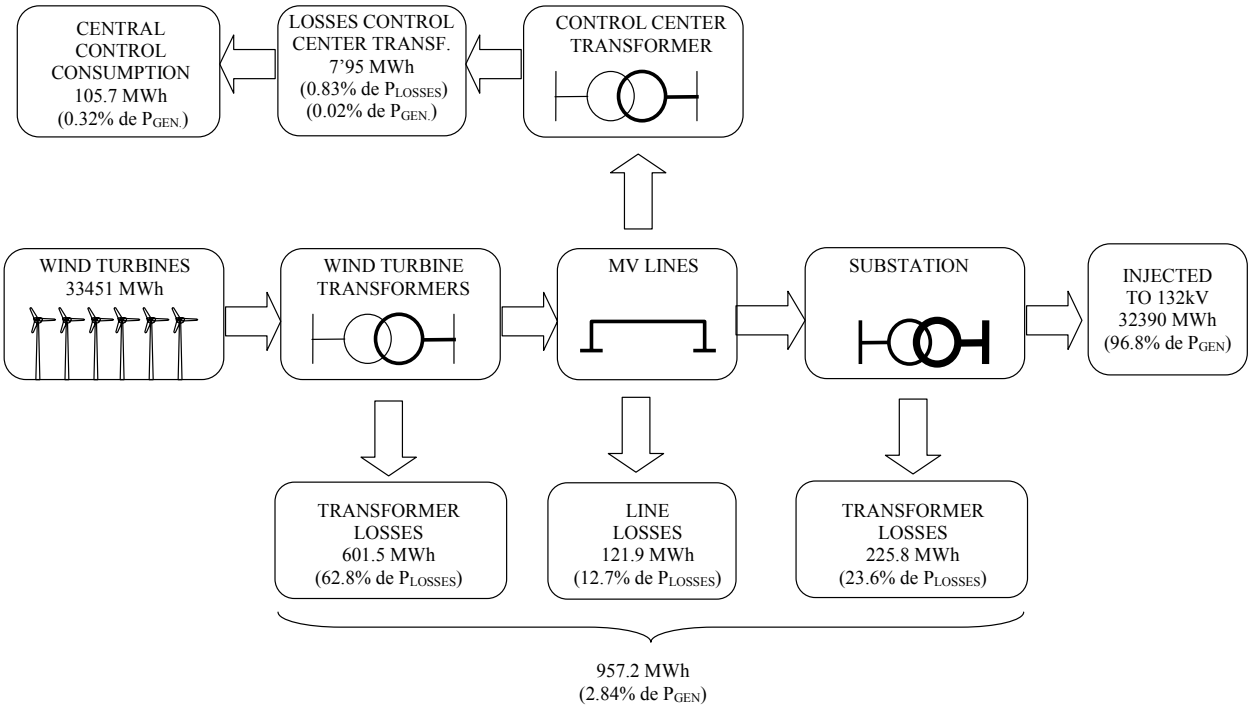


Figure 5 Active energy

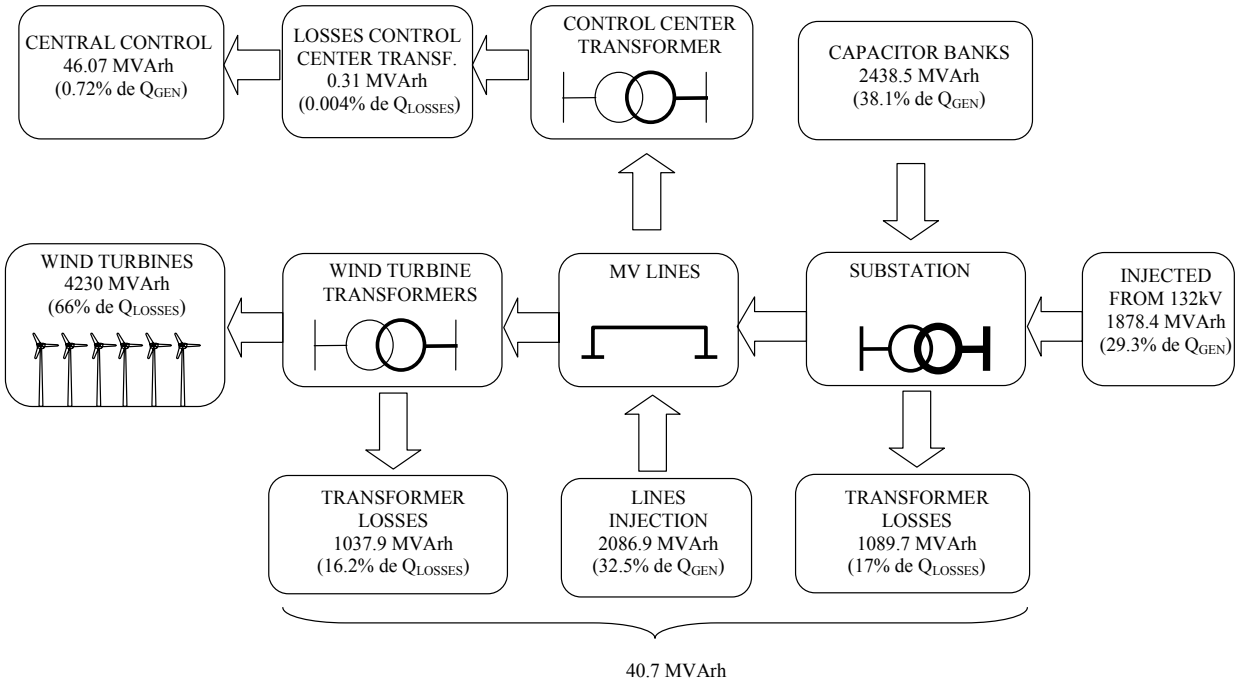


Figure 6 Reactive energy

APPENDIX A: ENERGY PRICES

AET:

- AET (2004): 7’2071c€
- AET (2005): 7’3304c€

Price for different options:

A) RD2818/98:

- Tariff(2004): 5.521 c€/kWh
- Subsidy(2004): 2.75 c€/kWh
- Tariff(2005): 5.616 c€/kWh
- Subsidy (2005): 2.357 c€/kWh

B) Sales to distributor:

- Price: 90% of AET for wind parks with less than 5 yeas, 85% AET from 6 to 10 years y 80% TRM for the rest
- Tariff (2004): 6’126c€/kWh for 85% AET
- Tariff (2005): 6’43c€/kWh for 85% AET

C) Market option:

- Price: Market price + 40% AET (premium) + 10% de TMR (Incentive) + 0’481 c€/kWh (capacity payment) - 0’025c€/kWh (operation costs)
- Penalties for deviations in the production forecast are not considered

APPENDIX B: WIND PARK DATA

TABLE III WIND TURBINES INSTALLED IN THE SOTAVENTO WIND PARK

Wind Turbine Model	Nº	Power (kW)	Pitch / Speed
Izar-Bonus 1.3 Mw	1	1300	Variable / Variable
Made AE - 46	4	660	Fixed / Fixed
Neg Micon NM-750	4	750	Fixed / Fixed
Neg Micon NM-900	1	900	Fixed / Fixed
Ecotecnia 44 - 640	4	640	Fixed / Fixed
Made AE-52	1	800	Variable / Variable
Izar-Bonus MK - IV	4	600	Fixed / Fixed
Gamesa G-47	4	660	Variable / Variable
Made AE - 61	1	1320	Fixed / Fixed

TABLE IV SUBSTATION CAPACITOR BANK

Capacitor Bank	Q (MVAr)
1	1’75
2	1’75

TABLE V TRANSFORMERS DATA

Nº Transf.	S (kVA)	U1 (V)	U2 (V)	Pfe (kW)	Pcu (kW)
1	1600	20000	690	3’1	14’24
2	1000	20000	690	2’3	9’79
3	775	20000	690/300	2’0	8’00
4	800	20000	690	2’1	8’37
5	700	20000	690	1’8	7’50
6	700	20000	690	1’8	7’50
7	775	20000	690/300	2’0	8’00
8	1000	20000	690	2’3	9’79
9	700	20000	690	1’8	7’50
10	700	20000	690	1’8	7’50
11	800	20000	690	2’1	8’37
12	1000	20000	690	2’3	9’79
13	1000	20000	690	2’3	9’79
14	775	20000	690/300	2’0	8’00
15	800	20000	690	2’1	8’37
16	800	20000	1000	2’1	8’37
17	700	20000	690	1’8	7’50
18	700	20000	690	1’8	7’50
19	775	20000	690/300	2’0	8’00
20	1000	20000	690	2’3	9’79
21	800	20000	690	2’1	8’37
22	700	20000	690	1’8	7’50
23	700	20000	690	1’8	7’50
24	1400	20000	690	3’0	13’00
29-30	26000	132000	20000	19	142
56-55	400	20000	400	0’7	2’80
60-59	50	20000	400	0’015	0’65

TABLE VI MV LINES

Nº line	Nude	L (m)	R (⍰/m)	X (⍰/m)	Co(⍰F/m)
30	31-32	195	0’161e-3	0’1e-3	0’268e-3
31	32-33	140	0’161e-3	0’1e-3	0’268e-3
32	33-34	160	0’161e-3	0’1e-3	0’268e-3
33	34-35	190	0’161e-3	0’1e-3	0’268e-3
34	35-36	140	0’161e-3	0’1e-3	0’268e-3
35	36-37	150	0’161e-3	0’1e-3	0’268e-3
36	37-38	120	0’161e-3	0’1e-3	0’268e-3
37	38-39	160	0’161e-3	0’1e-3	0’268e-3
38	39-40	150	0’161e-3	0’1e-3	0’268e-3
39	40-41	195	0’161e-3	0’1e-3	0’268e-3
40	41-42	182	0’161e-3	0’1e-3	0’268e-3
41	42-55	850	0’128e-3	0’105e-3	0’289e-3
42	43-44	250	0’128e-3	0’105e-3	0’289e-3
43	44-45	395	0’128e-3	0’105e-3	0’289e-3
44	45-46	160	0’161e-3	0’1e-3	0’268e-3
45	46-47	175	0’161e-3	0’1e-3	0’268e-3
46	47-48	160	0’161e-3	0’1e-3	0’268e-3
47	48-49	170	0’128e-3	0’105e-3	0’289e-3
48	49-50	175	0’128e-3	0’105e-3	0’289e-3
49	50-51	165	0’128e-3	0’105e-3	0’289e-3
50	51-52	200	0’128e-3	0’105e-3	0’289e-3
51	52-30	160	0’128e-3	0’105e-3	0’289e-3
52	53-52	170	0’128e-3	0’105e-3	0’289e-3
53	54-53	225	0’128e-3	0’105e-3	0’289e-3
54	55-30	2210	0’128e-3	0’105e-3	0’289e-3
55	57-30	11	0’641e-3	0’229e-3	0
56	58-30	8	0’641e-3	0’229e-3	0
57	59-30	10	0’641e-3	0’229e-3	0

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Welcome to EPQU'07 in Barcelona

It is our honour and pleasure to invite you to the 9th International Conference on Electrical Power Quality and Utilisation, taking place this time in Barcelona, Spain.

As a consequence of the technical quality and especial social atmosphere that has always characterized this series of conferences, the number of submitted papers shows a steady trend to increase. On this occasion, over 350 papers have been reviewed by the Scientific Committee, of which only 227 have been accepted for oral presentation. Many good papers had to be rejected because of the upper limit imposed by the number of parallel sessions. Apart from regular papers, the technical programme is completed with several tutorials, plenary sessions and a panel session that closes the conference.

The present 9th EPQU Conference is the continuation and development of previous conferences on the same or similar subject-matter, which have been organized in Poland by Electrical Power Engineering Institute of Technical University in Lodz and Institute of Electrical Drive and Industrial Equipment Control of AGH-University of Science and Technology in Krakow (since 1997) in collaboration with Azov Technical University of Mariupol (Ukraine) and Ukrainian National Academy of Sciences (Institute of Electrodynamics).

The first one entitled Electrical Power Quality in National Electrical Power System took place in Lodz in 1987. The next one entitled Electrical Energy Quality was organized in Spala (Poland) in 1991, and was followed by the third one named Efficiency and Quality of Electrical Power Supply for Industrial Plants, which was held in Mariupol (Ukraine) in 1994.

Since 1997 all conferences have been organized in Krakow with the same name: ELECTRICAL POWER QUALITY AND UTILISATION - 1997, 1999, 2001, 2003, 2005.

In 2005 the members of EPQU Conference scientific committee decided to change the place of the next – 9th EPQU Conference – to Spain and organize it in collaboration with CITCEA-UPC (www.citcea.upc.edu). We are sure that it was very good decision!

Thanks to our several sponsors, particularly ENDESA, the registration fee for the EPQU'07 is similar to past editions. We believe the social programme, traditionally composed of a reception, excursions and a gala dinner, is quite attractive and will satisfy the most exigent attendant.

The Local Organising Committee has made its best to assure that your stay in Barcelona is fruitful and joyful. The origins of Barcelona are previous to the Roman presence. The first stable human settlement may be located in the 6th century BC. Later, in the 3rd century BC, a not enough contrasted legend attributes to the Cartaginese leader Hannibal, the son of Amilcar Barca, the foundation of the city. The Romans came to Barcelona because of the wars that the two great Mediterranean powers, Roma and Cartago, fought by the end of the 3rd century BC. After the definitive Cartaginese defeat, the Romans incorporated the city to their domains.

The Barcelona of the 21st century is a city shaped by the '92 Olympics, a city transformed for and by the need to do justice to that great international event. The Barcelona we see around us now, the Barcelona we enjoy today, is a new Barcelona, Mediterranean in keeping with its traditions, with its face to the sea and its arms open to other cultures and peoples, giving and receiving, happy to make and to share its riches.

The Barcelona of the 21st century is an European capital of astonishing cultural energy and a passion for progress, a city whose day-to-day life brings together every imaginable facet of the most diverse activities: these are the potential that has fashioned the city's present and give it the impetus to move forward into the future.

We are looking forward to welcoming you in Barcelona!

Yours sincerely,



Antonio Gómez Expósito
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Julio García Mayordomo	*Universidad Politécnica de Madrid*	*Spain*
Walter Giménez	*Universidad Tecnológica Nacional*	*Argentina*
Emanuel Gluskin	*Holon Institute of Technology*	*Israel*
Dusan Graovac	*Infineon Technologies AG*	*Germany*
Jan H. Griffioen	*INNOMET*	*Netherlands*
José Luis Gutiérrez Iglesias	*UNESA*	*Spain*
Marek Hartman	*Gdynia Maritime University*	*Poland*
Bill Howe	*EPRI Solutions*	*USA*
Tahir Kapetanovic	*E-Control Austrian Energy Regulatory Authority*	*Austria*
Vladimir Katic	*University of Novi Sad*	*Serbia*
Włodzimierz Koczara	*Warsaw University of Technology*	*Poland*
Victor Levi	*United Utilities PLC*	*United Kingdom*
Ricardo López	*Instituto de Investigaciones Electricas*	*México*
Natasa Markovska	*Macedonian Academy of Sciences and Arts*	*Macedonia*
Christine Materazzi-Wagner	*Pöyry Energy GmbH*	*Austria*
José M. Maza Ortega	*University of Sevilla*	*Spain*
Alex McEachern	*Power Standards Laboratori*	*USA*
Mark MacGranaghan	*EPRI Solutions*	*USA*
Władysław Mielczarski	*Technical University of Lodz*	*Poland*
Rozmyslaw Mienski	*Tecnical University of Lodz*	*Poland*
Jovica Milanovic	*The University of Manchester*	*United Kingdom*
Janusz Mindykowski	*Gdynia Maritime University*	*Poland*
Dave Openshaw	*EDF Energy Networks Branch*	*UK*
Pere Palacín	*Ramon Llull University*	*Spain*
Igor Papič	*University of Ljubljana*	*Slovenia*
Estrella E. Parra	*Universidad Nacional*	*Colombia*
Maciej Pawlik	*Technical University of Lodz*	*Poland*
Francisco José Pazos	*Iberdrola*	*Spain*
Ángel Alberto Pérez	*MGE UPS Systems*	*Spain*
Paulo Ribeiro	*Calvin Collegue Michigan*	*USA*
Renato Rizzo	*University of Naples Federico II*	*Italy*
Alain Robert	*Université Catholique de Louvain*	*Belgium*
José M. Romero	*Endesa*	*Spain*
José A. Rosendo Macías	*University of Sevilla*	*Spain*
Josep M. Rovira	*Col·legi Oficial d'Enginyers Industrials de Catalunya*	*Spain*
Hugh Rudnick	*Pontificia Universidad Católica de Chile*	*Chile*
Knut Samdal	*Sintef Energy Research*	*Norway*
Marek Samotyj	*Electrical Power Research Institute*	*Poland*
Pavel Santarius	*Technical University of Ostrava*	*Czech Republic*
Jurij Sayenko	*Pryazovskyi State Technical University of Mariupol*	*Ukraine*
Gerd Schauer	*VERBUND-Austrian Hydro Power AG*	*Austria*
Marian Sobierajski	*Wroclaw University of Technology*	*Poland*
Zbigniew Styczynski	*Otto-von-Guericke-Universität Magdeburg*	*Germany*
Alfredo Testa	*Seconda Universitá di Napoli*	*Italy*
Julio Usaola García	*Universidad Carlos III de Madrid*	*Spain*
Fanica Vatra	*Society of Power Engineers in Romania*	*Romania*
Paola Verde	*Università degli studi di Cassino*	*Italy*
Yuriy Varetsky	*LVIV Polytechnic National University*	*Ukraine*
Eduardo Zabala	*Fundación LABEIN*	*Spain*
Dario Zaninelli	*Politecnico di Milano*	*Italy*
Ahmed Zobaa	*Cairo University*	*Egyp*

PROGRAMME AT GLANCE

PROGRAMME AT GLANCE
MONDAY, OCTOBER 8th

09:30 - 13:00 **TUTORIALS**	
T1: Practical Power Quality at World-wide Industrial and Commercial Sites	MoT01 Room: CosmoCaixa
T3: Energy Storage for Power Quality and Reliability	MoT03 Room: CosmoCaixa
15:00 - 18:30 **TUTORIALS**	
T2: Cost of Power Quality	MoT02 Room: CosmoCaixa
T4: Understanding Power Quality Measurements Results and Fault Disturbances	MoT04 Room: CosmoCaixa
17:00 - 19:00 **Conference Pre-registration**	

TUESDAY, OCTOBER 9 th

08:00 - 09:00 **Conference Registration**	
09:00 - 11:00 **Opening Session and Plenary: DSP Techniques for Power System Applications** **A.Gómez-Expósito, J.A. Rosendo**	TuMP Room: Auditorium
11:00 - 11:30 **Coffee Break**	
11:30 - 13:30 **TECHNICAL SESSIONS**	
1A-PARAMETERS OF PQ	TuM01 Room: Auditorium Chair: to be confirmed
1B-MODELING AND SIMULATION	TuM02 Room: A1 Chair: to be confirmed
1C-PQ MEASUREMENTS	TuM03 Room: A2+A3 Chair: Francisco Pazos Filgueira
1D-PQ IMPROVEMENT	TuM04 Room: A4 Chair: Igor Papic
13:30 - 15:00 **Lunch**	
15:00 - 17:00 **TECHNICAL SESSIONS**	
2A-MARKETS	TuA01 Room: Auditorium Chair: William Howe

2B-MODELING AND SIMULATION	**TuA02 Room: A1 Chair: Marek Hartman**
2C-PQ MEASUREMENTS	**TuA03 Room: A2+A3 Chair: Birgitte Bak-Jensen**
2D-PQ IMPROVEMENT	**TuA04 Room: 2D Chair: Fanica Vatra**
17:00 - 17:30 Coffee Break	
17:30 - 19:30 TECHNICAL SESSIONS	
3A-EMC	**TuE01 Room: Auditorium Chair: Oriol Boix**
3B-MODELING AND SIMULATION	**TuE02 Room: A1 Chair: Irena Wasiak**
3C-PQ MEASUREMENTS	**TuE03 Room: A2+A3 Chair: Pavel Santarius**
3D-PQ IMPROVEMENT	**TuE04 Room: A4 Chair: to be confirmed**
20:00 - 23:00 Welcome Party	

WEDNESDAY, OCTOBER 10 th

09:00 - 10:00 Plenary Session: LPQI vision:The future of Power Quality Quality of Electricity Supply: The initiatives of CEER/ERGEG	**WeMP Room: Auditorium**
10:00 - 11:00 Plenary Session: Power Quality Measurements Methods,Analyzers and Costs	**WeMP Room: Auditorium**
11:00 - 11:30 Coffee Break	
11:30 - 13:30 TECHNICAL SESSIONS	
4A-EMC, LOADS AND CONVERTERS	**WeM01 Room: Auditorium Chair: Eduardo Zabala**
4B-MODELING AND SIMULATION	**WeM02 Room: A1 Chair: Jovica Milanovic**
4C-DISTRIBUTED GENERATION AND RENEWABLE ENERGIES	**WeM03 Room: A2+A3 Chair: Koen Van Reusel**
4D-IMPROVEMENT AND DISTURBING LOADS	**WeM04 Room: A4 Chair: to be confirmed**

13:30 - 15:00	
Lunch	
15:00 - 17:00	
TECHNICAL SESSIONS	
5A-ECONOMIC ASPECTS	**WeA01 Room: Auditorium Chair: Paola Verde**
5B-MODELING AND SIMULATION	**WeA02 Room: A1 Chair: Antoni Sudrià**
5C-RELIABILITY OF SUPPLY AND DISTRIBUTED GENERATION	**WeA03 Room: A2+A3 Chair: Mircea Chindris**
5D-SENSIBILITY OF LOADS	**WeA04 Room: A4 Chair: Oriol Boix-Aragonès**
17:00 - 17:30	
Coffee Break	
17:30 - 19:30	
TECHNICAL SESSIONS	
6A-LOADS AND CONVERTERS	**WeE01 Room: Auditorium Chair: Zbigniew Hanzelka**
6B-RELIABILITY AND CONTINUITY OF SUPPLY	**WeE02 Room: A1 Chair: Salvador Baille**
6C-DISTRIBUTED GENERATION AND RENEWABLE ENERGY	**WeE03 Room: A2+A3 Chair: Samuel Galceran**
6D-PQ MEASUREMENTS	**WeE04 Room: A4 Chair: Emmanuel De Jaeger**
21:00 - 23:00	
Gala Dinner	

THURSDAY, OCTOBER 11 th

09:00 - 11:00	
TECHNICAL SESSIONS	
7A-HARMONICS	**ThM01 Room: Auditorium Chair: Jose Antonio Rosendo Macias**
7B-RELIABILITY AND CONTINUITY OF SUPPLY	**ThM02 Room: 7B Chair: to be confirmed**
7C-DISTRIBUTED GENERATION AND RENEWABLE ENERGY	**ThM03 Room: A2+A3 Chair: Maciej Tondos**
7D-PQ MEASUREMENTS	**ThM04 Room: A4 Chair: to be confirmed**
11:00 - 11:30	
Coffee Break	
11:30 - 13:30	
TECHNICAL SESSIONS	
P.Session 8A-Voltage dips in installations:Ongoing activities in	**ThA01**

international organizations	**Room: Auditorium** **Chair: Math Bollen**
P.Session 8B-Energy Efficiency	**ThA02** **Room: A1** **Chair: Franco Bua**
P.Session 8C:Distributed Generation and Renewable Energy+Reliability and Continuity of Supply	**ThA03** **Room: A2+A3** **Chair: Rodrigo Ramírez**
P.Session 8D-Education	**ThA04** **Room: A4** **Chair: to be confirmed**
13:30 - 14:00	
Closing Session	

TECHNICAL PROGRAMME

MONDAY, OCTOBER 8th

TECHNICAL PROGRAMME

MONDAY, OCTOBER 8th

09:30 - 13:00 **TUTORIALS**	
T1: Practical Power Quality at World-wide Industrial and Commercial Sites	**MoT01** **Room: CosmoCaixa**
T3: Energy Storage for Power Quality and Reliability	**MoT03** **Room: CosmoCaixa**
15:00 - 18:30 **TUTORIALS**	
T2: Cost of Power Quality	**MoT02** **Room: CosmoCaixa**
T4: Understanding Power Quality Measurements Results and Fault Disturbances	**MoT04** **Room: CosmoCaixa**
17:00 - 19:00 **Conference Pre-registration**	

TUESDAY, OCTOBER 9th

TUESDAY, OCTOBER 9th

08:00 - 09:00
Conference Registration

09:00 - 11:00
Opening Session and Plenary: DSP Techniques for Power System Applications
TuMP
Room: Auditorium

11:00 - 11:30
Coffee Break

11:30 - 13:30
TECHNICAL SESSIONS

1A-PARAMETERS OF PQ
TuM01
Room: Auditorium
Chair: to be confirmed

Obtaining Patterns for Classification of Power Quality Disturbances Using Biorthogonal Wavelets, RMS value and Support Vector Machines
V. Vega, C. Duarte, G. Ordóñez

A Simplified Implementation of the Test Protocol for the IEC Flickermeter
J.J. Gutiérrez, J. Ruíz, L.A. Leturiondo, A. Lazkano, I. Azpiri

Examples of International Flicker Requirements in High Voltage Networks and Real World Measurements
D. Arlt, M. Stark, C. Eberlein

Power Quality Problems in Regional Distribution Networks in the Czech Republic
P. Santarius, P. Krejčí, D. Spáčil, P. Vašenka

MPCA Approach for Localization of Electrical Sags
A. Khosravi, J. Meléndez, J. Colomer, J. Sánchez

Study of the Voltage Unbalance Conditions Based on the Behavior of the Voltage Unbalance Factor (CVUF)
A. Ferreira Filho, D. Garcia, F. Nascimento, M. Oliveira

On Global Index for Discrete Voltage Disturbances
G. Carpinelli, P. Varilone, P. Verde, P. Caramia, R. Chiumeo, I. Mastrandrea, F. Tarsia, O. Ornago

1B-MODELING AND SIMULATION
TuM02
Room: A1
Chair: to be confirmed

Database Development for Power Quality in PEA's Distribution System
W. Phongphat, S. Trin

Hybrid Time/frequency Domain Modelling of Nonlinear Components
W. Wiechowski, B. Bak-Jensen, C. Leth Bak, J. Lykkegaard

Network Reconfiguration in Radial Disrtibution System: Tabu Search
J. Dhiman, T. Thakur

Digital Simulation of Voltage Dip Characteristics of Wind Turbine Systems
A. Junyent, O. Gomis, M. Martinez, A. Sumper, M. Sala, M. Mata

Voltage Collapse Proximity Indicators for Radial Distribution Networks
S. Mangione, A. Augugliaro, L. Dusonchet

The Application of Fortescue's Transformation to describe Power States in Multi-phase Circuits with Non-sinusoidal Voltage and Currents
M.T. Hartman

1C-PQ MEASUREMENTS

TuM03
Room: A2+A3
Chair: Francisco Pazos Filgueira

Development of a Photovoltaic Array Emulator System based on a Full-bridge Structure
G. Martín, J. López, M. Teixidó, A. Sudrià

An Assessment of Distortion of Supply Voltage Waveform in All-Electric Ship Power Network - Case Study
M. Szweda, T. Tarasiuk

Influence of Power Factor Compensating Capacitors on Estimation of Harmonic Distortion
F.M. Fernández, P.S. Nair

Power Quality Monitoring System – Voltage Dips and Short Interruptions
D. Kottick, J. Furman

A New Approach to Reactive Power Calculation of the Static VAr Compensator
A. Osnach

New Developments in Power Quality Immunity and Voltage Sag Standards
A. Eberhard, A. McEachern

A New, Ultra-low-cost Power Quality Measurement Technology
A. McEachern

1D-PQ IMPROVEMENT

TuM04
Room: A4
Chair: Igor Papic

Harmonic Emission of Electronic Power Converters for Auxiliary Services in Electric Trains
M. Brenna, F. Foiadelli, M. Roscia, D. Zaninelli

Matrix Converter for reducing Harmonics in Micro-turbine Generation System
F. Jurado, M. Ortega, A. Cano

Photovoltaic-inverters as Active Filters to improve Power Quality in the Grid. What can State-of-the-art Equipment Achieve?
C. Mayr, R. Bründlinger, B. Bletterie

Inductive Decoupling of Low Voltage Sub-Networks
J. Jahn, A. Engler

Voltage Sag Cost Reduction With Optimally Placed FACTS Devices
J. Milanovic, Y. Zhang

Techno-economic Improvement of Voltage Sag Performance with FACTS Devices
Y. Zhang, J. Milanovic

Power Supply System for AC Contactor Ride-trough
P. Andrada, G. Navarro, J.I. Perat

13:30 - 15:00
Lunch

15:00 - 17:00
TECHNICAL SESSIONS

2A-MARKETS

TuA01
Room: Auditorium
Chair: William Howe

Electrical Power Delivery Improvement in Portugal through Quality Function Deployment
J. Delgado, P. Saraiva, A. Traça de Almeida

Power Quality in Romanian Electricity Market
C. Stanescu, V. Fanica, A. Poida, P. Postolache

Need of Voltage Quality Regulation in the Future Electricity Infrastructure
S. Bhattacharyya, J. Myrzik, J. Cobben, M. Lumig, M. Didden, W. Kling

Voltage Quality Issues in a Competitive Electricity Market
H.S. Bronzeado

Analysis of the Main Norms (standards) and Laws on Electrical Energy
A. Constantinescu, D. Constantinescu, D. Grigorescu, M. Covrig

2B-MODELING AND SIMULATION

TuA02
Room: A1
Chair: Marek Hartman

Using Complex Adaline for the Direct Symmetrical Components Estimation
S. Mortazavi, M. Joorabian, M. Mohseni

Monitoring Harmonic Sources in Distribution System By Neural Network Estimator
Y. Varetsky, T. Nakonechny

Harmonic Current Vector Method with Reference Impedances - Field Measurement Verification.
T. Pfajfar, B. Blažič, I. Papič

Fast Varying Loads
V. Bohorquez

CPC Power Theory as Control Algorithm of Switching Compensators
L.S. Czarnecki

Limitations of the IRP p-q Theory as Control Algorith
L.S. Czarnecki

Visual Management of Sags and Incidents Gathered in Distribution Substations for Power Quality Management
D. Macaya, J. Meléndez, J. Sánchez, M. Castro

2C-PQ MEASUREMENTS

TuA03
Room: A2+A3
Chair: Birgitte Bak-Jensen

The Impact of FIFA World Cup 2006 on Power Quality in the Electric Distribution systems
J. Rubens Macedo Jr., A. G. Martins, M. Jovita ,V. Siqueira, J. Renato ,V. Carneiro

System of Monitoring Power Quality Parameters in Real Time
V. Tukhas

An Experimental Evaluation of Short-Time Flicker Index
J. Klepacki

Metrological Supervision of Energy Meters in Power Distribution Plants up to 35kV.
S. Skundric, D. Naumovic Vukovic, A. Nikolic, D. Kovacevic

A New Approach to Voltage Measurements in Power System
D. Comic, S. Milovancev, V. Vujicic

The importance of IEC 61000-4-30 Class A for the Coordination of Power Quality Levels
R. Neumann

Power Quality Monitoring in the Romanian High Voltage Grid
D. Ilisiu

Building Permanent PQ Monitoring System on MV Network in Elektra Zagreb, Croatia
I. Klaric, G. Sagovac

2D-PQ IMPROVEMENT

TuA04
Room: 2D
Chair: Fanica Vatra

Dynamic Voltage Restorer (DVR) Using Three Dimensional PWM Control Algorithm
Z.L. Liew, A.K. Ramasamy, V.K. Ramachandaramurthy, R.K Iyer

Optimization of Compensation of Meshed MV Network by Modified Genetic Algorithm
M. Paar, P. Toman, H. Nielsen

Control of Dynamic Voltage Restorer using TMS320F2812
A.K. Ramasamy, R.K. Iyer, V.K. Ramachandaramurthy, Z.L. Liew

Central Control System Based on Genetic Algorithms to Improve Power Quality
R. Klempka, M. Tondos

Voltage Phase Controller for Power Systems
T. Sieńko, J. Szczepanik, T.J. Sobczyk

A Control Algorithm for Hybrid Compensation of Fast Varying Loads
V. Bohorquez

Active Earthing System to Optimise Power Quality in MV Networks
A. Amezua, F.J. Pazos, G. Santamaría, J.M. García, G. Buigues, I. Gutierrez

17:00 - 17:30
Coffee Break

17:30 - 19:30

TECHNICAL SESSIONS

3A-EMC

TuE01
Room: Auditorium
Chair: Oriol Boix

Flicker Impact on 150 W Lamps of Different Ages
M. Manana, A. Ortiz, F.J. Azcondo, F. Diaz, F. Gonzalez, C. Renedo

Effects of voltage sags on different types of ballasts for 150-W HPS lamps
F. Ortiz, A. Ortiz, M. Manana, C. Renedo , F.J. Díaz, F.J. Azcondo

Human Exposure to Power Frequency Electric and Magnetic Fields inside a Very High Voltage Power Station
C. Munteanu, I. T Pop, C. Diaconu, M. Ilia

Earthing Systems Design in Presence of Nonuniform Soil
G. Zizzo, A. Campoccia, E. Riva Sanseverino

Magnetic Losses Simulation in PM SM Drive by FE: Harmonic Superposition by Method of Locked Rotor
R. Kaczmarek, W.Y. Huang, J.C. Vannier

Numerical Methods for Induced Voltage Evaluation in Electromagnetic Interference Problems.
D.D. Micu, E. Simion, D. Micu, A. Ceclan

Magnetic Field Reduction Study for Low Voltage Distribution Panels located in MV/LV Substations
H. Beltran San Segundo, C. Cervelló García, V. Fuster Roig, T. Yebra Vega

3B-MODELING AND SIMULATION

TuE02
Room: A1
Chair: Irena Wasiak

Application for Fault Location in Electrical Power Distribution Systems
S. Herraiz, J. Meléndez, G. Ribugent, J. Sánchez, M. Castro

Harmonic Sources Localization: Comparison of Methods Utilizing the Voltage Rate or the Current Rate
K. Wilkosz

Dynamic Modeling of Induction Motor Loads For Transient Voltage Stability Studies
T. Aboul-Seoud

Modeling and Adaptive Control of an Electric Arc Furnace
R. Balan, O. Hancu, S. Stan, H. Balan

Harmonic Components Identification through the Adaline with Fuzzy Learning Parameter
M. Mohseni, M.A. Zamani

Search for Network Parameters preventing Ferroresonance Occurrence
J. Wisniewski, E. Anderson, J. Karolak

Designing Industrial Processes for PQ Resiliency
B. Fortenbery

3C-PQ MEASUREMENTS

TuE03
Room: A2+A3
Chair: Pavel Santarius

Flickermeter used for Different Type of Lamps
R. Cai, J. Cobben, J. Myrzik, W. Kling, J. Blom

The DFT Algorithms Analysis in Low-cost Power Quality Measurement System based on DSP Processor.
M. Szmajda, K. Gorecki, J. Mroczka

Power Quality effects on the Measurement of Reactive Power in Three-Phase Power Systems in the Light of the IEEE Standard 1459-2000.
V. Leon-Martinez, J. Montañana-Romeu, J. Giner-Garcia, A. Cazorla-Navarro, J. Roger-Folch, M.A. Graña-López

Data System for the Monitoring of Power Quality in the Transmission Substations Supplying Big Consumers
F. Vatra, A. Poida, C. Stanescu

Adaptive digital synchronization of measuring window in low-cost DSP power quality measurement systems
K. Gorecki, M. Szmajda, J. Mroczka

Estimation of Power System Parameters based on Load Variance Observations – Laboratory Studies
A. Bień, D. Borkowski, A. Wetula

Needs and Experiences for Acquiring the Experimental Capabilities fot the New Liberalized Framework of the Electricity Network
E. Perea, A. Gil de Muro, E. Zabala

3D-PQ IMPROVEMENT

TuE04
Room: Cosmocaixa
Chair: to be confirmed

PFC Units Sizing in Steel Factory Harmonics Environment: A Case Study
A. Baggini, F. Bua, F. Buratti, A. Ascolari

Improving the Voltage Regulation of Secondary Feeders by Applying Solid-state Tap Chagers to MV/LV Transformers
D. Monroy, A. Gómez-Expósito, E. Romero-Ramos

Problems of Passive Filters Application in System with Varying Frequency
J. Mindykowski, P. Rupnik, T. Tarasiuk

Recursive Control for Active Power Filters
R. Magureanu, D. Creanga, V. Bostan, M. Priboianu

Electrical Power Quality Improvement using a DSP Controlled Active Power Filter
C. Patrascu, D. Popescu, A. Iacob

Modeling for passive hybrid filter performance analysis.
L.L. Ravagnani, L.C. Oliveira, D.L. Milanese
F. Schorr

Application of DSTATCOMCompensators for Mitigation of Power Quality Deviations in Low Voltage Grid with Distributed Generation
P. Gburczyk, R. Mienski, R. Pawelek, I. Wasiak

20:00 - 23:00

Welcome Party Room: BCN World

WEDNESDAY, OCTOBER 10th

WEDNESDAY, OCTOBER 10 th

09:00 - 10:00
Plenary Session: LPQI vision: The future of Power Quality
Isabelle Herikian
Quality of Electricity Supply: The initiatives of CEER/ERGEG
Luca LoSchiavo

WeMP
Room: Auditorium

10:00 - 11:00
Plenary Session: Power Quality Measurements Methods,Analyzers and Costs
Juan Martínez

WeMP
Room: Auditorium

11:00 - 11:30
Coffee Break

11:30 - 13:30
TECHNICAL SESSIONS

4A-EMC, LOADS AND CONVERTERS

WeM01
Room: Auditorium
Chair: Eduardo Zabala

Feasibility Study of Advancing and Sitting up Power Line Communication (PLC) System under Circumstances of Electromagnetic Compatibility (EMC) on the Ships
M. Bakkali, C. Mascareñas, F. Sánchez de la Campa, C. Martín, F.J. Abad, M. Barea, J.M. Valverde, J. Valencia, J.E. Chover

Possible Design of Bus Bar Construction for Matrix Converter
I. Galkin, A. Sokolovs

Evaluation of PLL's Technologies for the Calculation of the Electrical Network Frequency in Single Phase Systems
H. Rivas, J. Bergas

Assessment of Electromagnetic Disturbances Transfer between Networks
P. Gburczyk, R. Mienski, R. Pawelek, I. Wasiak, W. Kepinski

Virtual Synchronous Machine
R. Hesse, H.P. Beck, D. Turschner

Frequency Converters as Sources of Interharmonics
I. Zhezhelenko, Y. Sayenko, T. Baranenko

High Voltage Auxiliary Power Supply with the Simplified Power Circuit Topology for the DC Trains
D. Vinnikov, J. Laugis

4B-MODELING AND SIMULATION

WeM02
Room: A1
Chair: Jovica Milanovic

Analysis of Voltage Profile And Its Improvement In Harmonic Included Distribution Systems
S. Galvani, H. Hosseinian, S.H. Hosseini, F. Shahnia

Analysis of HV and MV networks faults effect on short drops
G. Nicolau, J.R. Regué, R. Bosch

Voltage Quality Improvement in Distribution Networks
C. Zúñiga

Voltage Estimation in Electrical Distribution Systems
J.O. Pinto, R.B. Godoy, L. Galotto

Multiple Signal Processing Techniques Based Power Quality Disturbance Detection, Classification, and Diagnostic Software
J.O. Pinto, R.B. Godoy, L. Galotto

Case Studies of Harmonic Problems, Analysis, and Solutions on Transmission Systems
D. Mueller

4C-DISTRIBUTED GENERATION AND RENEWABLE ENERGIES

WeM03
Room: A2+A3
Chair: Koen Van Reusel

A Study of Electric Power Quality using Storage System in Distributed Generation
K. Yukita, Y. Goto, K. Ichiyanagi, K. Hirose

Impact of Embedded Generation on the Voltage Quality of Distribution Networks
G. Esposito, N. Golovanov, C. Lazaroiu, D. Zaninelli

Comparison between Solar and Wind Energy in Lebanon
A. El-Ali, N. Moubayed, R. Outbib

Innovative Training Techniques to Account for Power Quality Issues when Deploying Distributed Energy Resources
C. Coujard, S. Galant, A. Vafeas, S. Grenard, M. Bollen, R. Rodriguez

Distributed Generation Impact on Voltage Sags in Distribution Networks
J.A. Martinez-Velasco, J. Martin-Arnedo

Grid Connected Wind Turbine-Fuel Cell Power System Having Power Quality Issues
M. Gaiceanu, G. Fetecau

4D-IMPROVEMENT AND DISTURBING LOADS

WeM04
Room: A4
Chair: to be confirmed

LC Coupled Shunt Active Power Filter (APF): New Topology and Control Methods
J. Balcells, M. Lamich, D. González, J. Gago

Damped-Type Double Tuned Filters Design for HVDC Systems
M.A. Zamani, M. Mohseni

Paper Ref: 203 Title: Active Compensation of Harmonics in Industrial Applications

S. Kalaschnikow, S. Hansen, L. Asiminoaei, H. Gedde Moos

Electric Arc Furnace Modelling from a "Power Quality" Point of View
I. Vervenne, K. Van Reusel, R. Belmans

Propagation of Unbalance in Electric Power Systems
M. Chindris, A. Sudrià, A. Cziker, A. Miron, H. Balan, A. Iacob

Integrated Approach for Power Quality requirements at the Point of Connection
J. Cobben, S. Bhattacharyya, J. Myrzik, W. Kling

Dynamic Harmonic Mitigation and Power Factor Correction

C. Chavez, J. Houdek

13:30 - 15:00
Lunch

15:00 - 17:00
TECHNICAL SESSIONS

5A-ECONOMIC ASPECTS
WeA01
Room: Auditorium
Chair: Paola Verde

Economical Damage due to Low Power Quality
I. Zhezhelenko, Y. Sayenko, A. Gorpinich

Creating a Regulatory Framework for Voltage Quality
B. Franken, V. Ajodhia, K. Keller, K. Petrov, C. Müller

Overview of Electricity Deregulation, Power Quality and Energy Efficiency Studies in Turkey
Ö. Gül

Planning for "High Quality" Distribution Networks
F. Pilo, G. Pisano, G.G. Soma

The Costs of Keeping Reliability of Electrical Devices in Power Enterprise.
W. Kopterski

Methodology for Assessment of Financial Losses due to Voltage Sags and Short Interruptions
J. Chan, J. Milanovic

Pan-European Power Quality Survey - a study of the impact of poor power quality on electrical energy critical industrial sectors
R. Targosz, J. Manson

5B-MODELING AND SIMULATION
WeA02
Room: A1
Chair: Antoni Sudrià

Flashover Rate Due Lightning in Overhead Distribution Lines
C. Vásquez, C. Blanco, W. Osal

Simulation of Electric Quantities in Lighting Networks
E. Konečná

Time-Series Load Modelling and Load Forecasting Using Neuro-Fuzzy Techniques
Z. Haydari, A. Mohammadi , F. Kavehnia, M. Ghanbarian, M. Askari

Computer Aided Online Fault Diagnosis of Induction Motors
Suri Sathya Prashant S.Shyam Sunder K.SatyaKrishna S.A.Sharma

S.A. Sharma, S. Sathya Prashant, S. Shyam Sunder, K. Satya Krishna

Impedance Measurement of a Fuel Cell on Load
E. Aglzim, A. Rouane, B. Kraemer, R. El Moznine

ANETO: A tool for the Automatic Generation of Base-case Theoretical Network Models
A. Gómez, G. Tévar, M. Rodríguez, J.A. García

Evaluation and Trends of Power Quality Indices in Distribution System
E. Mertens, L. Dias, F. Fernandes, B. Bonatto, J. Abreu, H. Arango

5C-RELIABILITY OF SUPPLY AND DISTRIBUTED GENERATION

WeA03
Room: A2+A3
Chair: Mircea Chindris

Reliability of Large Power Units in Probabilistic Approach
J. Buchta, A. Oziemski

Assessing Fault Tolerant Power Infrastructures : An approach using Operating Dependability Study Methods
J.F. Christin, A.A. Pérez, J. Sallent

Micro storage in distributed PV grid-connected installations and Demand Side Management
X. Vallvé, A. Graillot, S. Gual, H. Colin

Steady State Model of 100kWe SOFC Power Conditioning System
M. Gaiceanu, G. Orsello

Impact of Distributed Generation over Power Losses on Distribution System
F. Gonzalez-Longatt

Mitigating Voltage Sag By Optimal Allocation of Distributed Generation Using Genetic Algorithm
M. Jenabali Jahromi, E. Farjah, M. Zolghadri

Distributed generation and renewable energy sources in Poland.
J. Paska

5D-SENSIBILITY OF LOADS

WeA04
Room: A4
Chair: Oriol Boix-Aragonès

Electrical Quality Requirements for Scientific Applications. The ALBA Synchrotron Light Source Case.
M. Cusidó, LL. Miralles

Affect of Voltage Sags on Electro-magnetic Contactor
I. Iyoda, M. Hirata, N. Shigei, S. Pounyakhet, K. Ota, T. Ise

PWM Inverters for Stand-alone Single-phase High Quality Power Generation.
R. Lima, A. Mendes, A. Almeida, A. Cardoso

Contributions to Analysis of Energetical Performances of Auxiliary Equipments of Luminaries
S. Diga, D. Rusinaru, F. Ivan

Characterisation of Centralized CSS supplied Emergency Lighting Equipment Behaviour
M. Granziero, M. Cappellari, F. Bua, A. Baggini

A Study of Voltage Sags in Electric Motors. Development of a sag generator
J. Perez, C. Cortes, A. Gomez

CIGRE/CIRED/UIE JWG C4.110 Voltage dip immunity of equipment in installations

M. Bollen, M. Stephens, K. Stockman, S. Djokic, A. McEachern, J. Gordon

17:00 - 17:30
Coffee Break

17:30 - 19:30
TECHNICAL SESSIONS

6A-LOADS AND CONVERTERS

WeE01
Room: Auditorium
Chair: Zbigniew Hanzelka

Power Quality Problems in Unbalanced Operations of Fault Tolerant H-bridge Multilevel Active Front-ends
G. Brando, A. Dannier, A. Del Pizzo, R. Rizzo

Methodology for Assessing the Impact of Short-Term Voltage Variations (Sags) on Power Electronic Equipment
C. Trujillo, H. Torres, A. Pavas, J. Guacaneme

Switching Power Supplies: Experimental Analysis of Absorbed Powers
R. Langella, A. Testa

Influence of Modulation Frequency on the Properties of the Induction Motor, which is supplied from Frequency Converter.
J. Kubin, E. Konecna

An Innovative Approach for Condition Monitoring and Fault Diagnosis of Induction Motor by estimation of Rotor Time constant using Extended Kalman Filter
P. Parthasaradhy, S. Sathya Prashant, S. Shyam Sunder, K. Satya Krishna

Series-Connected DC-DC Power Converters for Low-Voltage DC Source in Distributed Generation
C. Pica, R. Bojoi, G. Griva, A. Tenconi

Static Switches for their use on Capacitors Batteries connection
R. Camell, Q. López, M. Teixidó, H. Rivas, A. Sudrià

6B-RELIABILITY AND CONTINUITY OF SUPPLY

WeE02
Room: A1
Chair: Salvador Baille

New Power Quality Solutions Especially Designed For Industrial Applications
F. Ferrandis, A. Barona, J. Olarte, J.L. Iribarren

Design of Emergency Power Systems For Reliable Uninterrupted High Power Applications.
D. Sarussi, C. Kornfeld

Electrical Power, Quality Improvement in the Eastern European Reagion
D. Fita, L. Muresan, R. Borz

Reliability analysis of distribution networks.
R. Gono, M. Kratky, S. Rusek

Energy Sustainability in Sub-Saharan Africa
D. Nchelatebe Nkwetta, V. Van Thong, J. Driesen, R. Belmans

Regulation of the Electricity Supply Continuity and Decision making of Distribution Companies about Measures to be undertaken in the Network.
V. Detrich, P. Skala, Z. Spacek, V. Blazek

Reliability Centered Maintenance
E. Mascarell

INCA: A Tool for Assessment and Improvement of Supply Reliability Indices
J.A. Rosendo, A. Gomez, J.L Martínez, G. Tévar, M. Rodríguez

6C-DISTRIBUTED GENERATION AND RENEWABLE ENERGY

WeE03
Room: A2+A3
Chair: Samuel Galceran

Estimation of the Energy Losses in a Wind Park
E. Diaz-Dorado, C.J. Carrillo, J. Cidrás, E. Albo

Harmonics Effect caused by Large Scale PV Installations in a LV Network
M.C Benhabib, J.M Myrzik , J.L. Duarte

Compensation of Fast Changing Loads - Application Example Wind Turbines
P. Goldstrass, A. Kartal

Analyzing the Quality of Supply under the Insight of the DC Networks
F.J. Santiago, A. Gil de Muro, J. Anduaga

An Anti-islanding Control System for Distributed Generation Plants with Synchronous Machines
L. Piegari, R. Rizzo, P. Tricoli

Development of a Tool for Calculating the Effects of PV-systems connected to a Low Voltage GRID
C. Gonzalez, A. Sumper, R. Ramirez, R. Villafáfila, O. Boix, M. Chindris

Field Demonstration on Multiple Power Quality Supply System in Sendai, Japan
K. Hirose, T. Takeda, A. Fukui

6D-PQ MEASUREMENTS

WeE04
Room: A4
Chair: Emmanuel De Jaeger

Validation techniques of network harmonic models based on switching of a series linear component and measuring resultant harmonic increments
W. Wiechowski, B. Bak Jensen, C. Leth Bak, J. Lykkegaard

GPS-synchronized harmonic measurements performed on a 400 kV transmission network
W. Wiechowski, B. Bak Jensen, C. Leth Bak, J. Lykkegaard, J. Wasilewski

Single-Point Strategies for the Detection of Harmonic Sources in Power Systems
A. Cataliotti, V. Cosentino, M.G. Ippolito, G. Morana, S. Nuccio

Monitoring Power Quality beyond EN 50160 and IEC 61000-4-30
A. Broshi

Observability of Power System Behaviour by Optimal Located Phasor Measurement Units
P. Komarnicki, C. Dzienis, Z.A. Styczynski, G. Müller, I. Gollub, J. Blumschein

The Design and Construction of Power Quality Parameters Recorder
M. Rogóż, Z. Hanzelka

Field Measurements on Wind Turbines: a Voltage Dip Characterization under the Spanish Grid Code
E. Gomez, M. Cañas, J.A. Fuentes, A. Molina, F. Jimenez

21:00 - 23:00
Gala Dinner **Room: Auditorium**

THURSDAY, OCTOBER 11th

THURSDAY, OCTOBER 11 th

09:00 - 11:00

TECHNICAL SESSIONS

7A-HARMONICS

ThM01
Room: Auditorium
Chair: Jose Antonio Rosendo Macias

Harmonics Consideration of a RSFCL in a 11kV Distribution System
H. Heydari, H. Hooshyar, M. Savaghebi, R. Sharifi

The Practical Application of the Method Enabling to determine the Participation of the Customer and Utility in the Harmonic Distortions at the PCC.
K. Kuryło

Choice of Harmonic Filters for a High Voltage Network with Distributed Non-linear Load
L. Kovernikova

Power System Harmonic Estimation using Neural Networks
B. Swiatek, M. Rogoz, Z. Hanzelka

Application Examples of Broadband Active Harmonic Filter Systems in Four Specific Industries
J. Johnson, I. Evans

Reducing Heat in a Transformer and increasing its Loading Capacity, by decreasing the Percentage of Harmonics and Reactive Power within the Distribution Network of an Industrial Consumer
M. Duta, A. Iacob, S. Popescu, M. Serb, M. Bernea

Harmonic Analysis in Ideal and Nonideal
F.N. Belchior, J.P Abreu, H. Arango

7B-RELIABILITY AND CONTINUITY OF SUPPLY

ThM02
Room: A1
Chair: to be confirmed

Development of Search Space Establishment-less Type High Speed Genetic Algorithm Considering Mutation Rate and Using Parallel Computer
T. Ujiie, Y. Mizutani, K. Mizutani, M. Leelajindakrairerk

Methodologies and Tools for Electric Power System Reliability Assessment on HL I and HL II Levels.
J. Paska

Problems of Deployment of RC Switching Elements in Distribution MV Networks for Improving Reliability of Power Supply
P. Moldřík, J. Gurecký, P. Krejčí, L. Paszek

Decentralized Control of a Different Rated Parallel UPS Systems
R. Strzelecki, D. Wojciechowski

Reactive Power Control in Transmission Network as a Tool for Reliable Supply
G. Blajszczak

Selection of High-power Static UPS
R. Villafáfila, A. Sumper, D. Montesinos, A. Sudrià

Reliability Evaluation of Photovoltaic and Mini Wind Plant interconnected with UPS
A. Burgio, D. Menniti, A. Pinnarelli, N. Sorrentino

7C-DISTRIBUTED GENERATION AND RENEWABLE ENERGY

ThM03
Room: A2+A3
Chair: Maciej Tondos

Improving Power Quality with coordinated Voltage Control in Networks with Dispersed Generation.
T. Pfajfar, I. Papič, B. Bletterie, H. Brunner

Control of a DFIG-based Wind System in presence of Large Grid Faults: Analysis of Voltage Ride through Capability
J. Arbi, I. Slama-Belkhodja, S. Arnalte

Exploitation of Renewable Power Sources for Local consumers' Reservation
J. Rozenkrons, A. Staltmanis

The Load Flow Calculation in Unbalanced Radial Electric Networks with Distributed Generation
M. Chindris, A. Sudria, B. Tomoiaga, C. Bud

The Load Flow Calculation in Harmonic Polluted Radial Electric Networks with Distributed Generation
C. Bud, B. Tomoiaga, M. Chindris, A. Sudria

Improving Power Quality in Remote Wind Energy Systems Using Battery Storage
T. Aboul-Seoud

Pace of Tower Shadow Fluctuations in a Wind Farm (Speaker: *A.A. Bayod-Rujula)*
J. Mur-Amada, A.A. Bayod-Rujula

Wind Power Variability Model. Part III – Validation of the model (Speaker: *A.A. Bayod-Rujula)*
J. Mur-Amada, A.A. Bayod-Rujula

Characterization of Spectral Density of Wind Farm Power Output (Speaker: *A.A. Bayod-Rujula)*
J. Mur-Amada, A.A. Bayod-Rujula

7D-PQ MEASUREMENTS

ThM04
Room: A4
Chair: to be confirmed

Optimal Measurement Devices Allocation for Harmonic State Estimation Considering Parameters Uncertainty in Distribution Networks
C. Muscas, F. Pilo, G. Pisano, S. Sulis

Methods for Power Quality Analysis according to EN 50160.
A. Nikolic, D. Naumovic Vukovic, S. Skundric, D. Kovacevic, V. Milenkovic

Modular System For Distributed Power Quality Monitoring.
P. Bilik, L. Koval, J. Hula

PEA's Premium Power Service: Baseline and Risk Assessment
Ch. Madtharad, Ch. Sorndit, S. Premrudeepreechacharn, M. MacGranaghan

Evolution of processing signal techniques in power quality
T. Yebra, V. Fuster, H. Beltrán

Method for Characterizing Measured Three-phase Unbalanced Voltage Sags
M. Madrigal, B.H. Rocha

Power Quality Measurements at an Automobile Factory.Conclusion
M. Pérez Donsión

Automatic System for Distance Reading of Static
G. Nakov

11:00 - 11:30
Coffee Break

11:30 - 13:30
TECHNICAL SESSIONS

P.Session 8A-Voltage dips in installations:Ongoing activities in international organizations

ThA01
Room: Auditorium
Chair: Math Bollen

Immunity of Voltage Dips in Installations
M. Bollen

Equipment and Process Behaviour during Voltage Dips
K. Stockman

Statistical and Economical Data on Voltage Dips
A. McEachern

Economic Framework for Power Quality, Joint Working Group C4.107
J. Milanovic

Other Power Quality Activities within International Organisations
M. Bollen

8B-Energy Efficiency

ThA02
Room: A1
Chair: Franco Bua

Utilization of the Standard-voltage-range in Low-voltage Networks for the usage of Local-Energy-Controllers without affecting the Powerquality
P. Kadel

Standby Power Consumption in Belgium
K. Clement-Nyns, I. Pardon, J. Driesen

Total Reliable Efficiency (TRE). A Global Approach for Continuous Energy Improvement
J. Daura, R. Steinbauer

Energy Efficiency of Distribution Transformers in Europe
R. Targosz, F. Topalis, W. Irrek, J. Frau, A. Baginski, A. Klimowicz, A. Rialhe, J.O. Budin, J. Szkutnik

Energy Efficient Transformer Selection Implementing Life Cycle Costs and Environmental Externalities
E. Amoiralis, M. Tsili, P. Georgilakis, A. Kladas

Ant Colony Solution to Optimal Transformer Sizing Problem
E. Amoiralis, M. Tsili, P. Georgilakis, A. Kladas

The High-Frequency Interferences Produced in Systems what Includes the Pulse Width Modulation Inverter and AC Motors
E. Darie

8C:Distributed Generation and Renewable Energy+Reliability and Continuity of Supply

ThA03
Room: A2+A3
Chair: Rodrigo Ramírez

Study of Power Fluctuation from Dispersed Generations and loads and its impact on a Distribution Network through a Probabilistic Approach.
P. Chen, Z. Chen, B. Bak-Jensen, R. Villafáfila, S. Sörensen

Coordinated Reactive Compensation in a Wind Park
E. Diaz-Dorado, C.J. Carrillo, J. Cidrás

A New Heuristic Network Reconfiguration Algorithm for Radial Distribution System
J. Dhiman, T. Thakur

Reliability and Continuity of Supply
C. Musonda, K. Kasonkomona

Study on Adaptive Power System Stabilizing Control calculated by "Search Space Establishment-less Type Genetic Algorithm Considering Mutation Rate (MSSELGA)"
Y. Hirabayasi, Y. Mizutani, K. Mizutani, M. Leelajindakrairerk

Development and implementation of a Condition Monitoring System in a Substation
J. Velásquez, R. Villafáfila, P. Lloret, Ll. Molas, S. Galceran, A. Sumper

IEC 61850 as a Flexible Tool for Electrical Systems Monitoring
P. Lloret, J.L. Velásquez, L. Molas, R. Villafáfila, S. Galceran, A. Sumper

8D-Education and Economical Aspects

ThA04
Room: A4
Chair: Anibal de Almeida

A Free Simulator Program for Teaching Power Quality Concepts
A. McEachern

Power Quality between Necessity and Tradition in Master Courses Curricula of Romanian Electrical Engineering Faculties
D. Rusinaru, I. Mircea, S. Diga, F. Ivan

A New Vision of PQ Research for the Next 10 Years-Revised
W. Howe

Power quality education using a remote monitoring laboratory
A. Sumper, R. Villafáfila, L. Molas, O. Gomis, S. Lopez, R. Ambrona

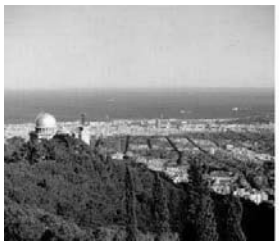
DERLab – Distributed Generation Test Facility
P. Gburczyk, R. Mienski, R. Pawelek, I. Wasiak

Cardinal fusses and barriers of the transition in the energy sector of Republic Bulgaria
J. Angelova

Analysis of Electrical Power Sale Costs by the Use of "Sensitivity Analysis" Method
J. Angelova

13:30 - 14:00
Closing Session **Room: Auditorium**

SOCIAL TOUR





PANORAMIC BARCELONA

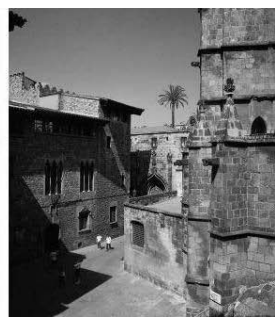
From the mountains to the sea

9th October - morning

A panoramic tour of the city, from the mountain to the sea, passing through some of the most representative avenues and buildings: Montjuïc Mountain, stop to admire a panoramic view of the city and the Port, the Ramblas, the Paseo de Gracia, the Diagonal, the Sagrada Família and the Olympic Port.

Price per person: **45 €**





HISTORICAL BARCELONA

Stories and legends of the Gothic Quarter

9th October - afternoon

A walk through the old quarter of the city, where plentiful remains of the old Roman Walls and constructions can be seen, and the great Gothic buildings, witness to the ascendancy of the city and its culture in the Middle Ages. The trip goes via the Ramblas, the Mercado de la Boqueria, Plaza Sant Jaume, where the Palau de la Generalitat and the City Hall are situated, the Cathedral and its cloister, and the Plaza del Pi.

Price per person: **50 €**



WINE CELLARS AND MONTSERRAT

Magic day in the Catalonian Holy mountain and the Codorniu cellars

10th October - all day

An outing to the Codorniu cellars, in the Penedés area, about 30 Kilometres from Barcelona. The Penedés is the wine-growing region which created the "cava", a sparkling wine vintage of worldwide renown. During the trip you will visit the cellars and see the winemaking process. Then we shall go to Montserrat, the holy mountain of Catalonia, a majestic mountain about 60 kilometres from Barcelona. It name comes from its special silhouette, cut by erosion into a saw shape. The Royal Basilica houses the picture of the legendary "Virgen Morena", patron saint of Catalonia. Catalan lunch not far from Montserrat.

Price per person: **100 €**





GALA DINNER

Maremagnum Convention Centre

10th October - night

The Sala Maremagnum, a hall with a total indoor surface area of 900 sq.m. and a private terrace measuring some 550 sq. m. with exclusive direct access through the gall itself. From the sala Maremagnum, one can see the city's skyline from the sea, the Columbus monument, Montjuïc mountain, the Port of Barcelona, etc…

Price per person: **80 €**





BARCELONA GAUDÍ TOUR

Modernist designs and Colours

11th October - morning

The Modernist movement is reflected in the architecture of the "Eixample" district. A central sector of the Eixample is the Quadrat d'Or (Golden Square) because of its concentration of Modernist Buildings. A trip through the Catalan Modernism - Art Deco, Modern Style - an artistic current which manifested in Europe around the turn of the century whose main features are the variety of forms and the richness of its decorative elements. A large proportion of the masterpieces of modernist architects such as Gaudí, Domènech i Montaner and Puig i Cadafalch are concentrated in the "Eixample" quarter. A visit to the Templo de la Sagrada Família (Holy Temple), probably the most famous of Gaudi's works, is still being built according to his initial project. The catalogue of constructions by Gaudí does not end here, we can visit the masterpiece of his work: the Parque Güell, now UNESCO heritage, where nature and art coexist in a same place. This fantasy garden is also one of the best spots from which the city can be seen.

Price per person: 45 €