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EDITORIAL



Dear Reader,

The continuous growing integration of renewable energy sources, the needs for an environmentally friendly energy system, the uprising of energy storage solutions and more generally the deployment of the concept of Smart Grids changed completely the context under which power systems are operated nowadays.

Simultaneously, the digitalization of the power system, i.e. the usage of digital solutions in power systems, is also taking place all around the world.

Under this context, and to leverage the application of new products/ solutions, we are following-up on the information provided in a previous Newsletter, to share with you that R&D Nester has currently operational a Real Time Power System Simulation (RTPSS) Laboratory, providing a unique research and simulation infrastructure to analyze the behavior of different components of the power system. In the Technical Information Section we offer you further information on this topic.

We also bring to your attention two innovative projects in which R&D Nester is participating. "SusCity: Urban data driven models for creative and resourceful urban transitions" is a project that addresses the hot topic of Sustainable Cities, and R&D Nester is participating in the context of electrical "integration and system operation. "ISSWINDemo" is a project with the goal of demonstrating the added value of applying remote sensing and global navigation satellite system to supporting services for wind power industry, and R&D Nester is involved from the view points of the benefits to the electrical system operation.

We further highlight two relevant events that occurred during the last weeks and in which R&D Nester took part. These were the bi-annual CIGRÉ Meeting and the Photovoltaica Exhibition and Conference. Check the details below.

As in the previous edition, the Newsletter is also enriched with some interesting links and information on EU R&D and Innovation issues. Also don't forget to test your knowledge on power systems with our popular section "Quiz"!

You will find more on this and other topics in the notes below. We hope that you find the minutes spent with us both relevant and rewarding. Enjoy your reading and please continue to share with us your feedback!

Sincerely,

Nuno de Souza e Silva
General Manager



HIGHLIGHTS



R&D NESTER PRESENTS INNOVATIVE PROJECTS AT PHOTOVOLTAICA 2016

R&D Nester attended the 2nd edition of Photovoltaica - International Solar Energy Exhibition & Conference, an important event in the energy sector worldwide, which had Africa as a guest of honor in this, with the participation of countries from sub-Saharan Africa. The event was held in Casablanca, Morocco, from 7 to 9 September.

On opening day, the panel included a presentation by the President of REN, Rodrigo Costa, who approached the theme "The role of the grid and the Interconnections".

The stand of Centre for Research and Development created by REN and the State Grid Corporation of China, was visited by several entities and personalities, including the Secretary of State for Energy of Portugal, the Minister of Energy, Mines, Water and Environment of the Kingdom of Morocco and the Minister of Energy and Water of Mali.

Nuno Souza e Silva, Managing Director of REN and State Grid Centre for Research and Development, ranked the participation of R&D Nester in this event as "an excellent opportunity to make known to the Moroccan market the activity and developed work of R&D Nester in different areas of electrical systems, such as planning, interconnects, power system operation and renewable energy integration." These areas are "particularly relevant for both Morocco and Portugal, and R&D Nester can make a significant contribution." There are entities that should be mentioned among all contacts, ONEE, Office National de l'Electricité et de l'Eau Potable, MASEN, Moroccan Agency for Solar Energy, IRESEN, Institute of Recherche en Energie Solaire et en Energies Nouvelles, and

According to Nuno Souza e Silva, this participation in the second edition of Photovoltaïca was the perfect platform to promote the innovative work that R&D Nester has been developing in different areas of research that highlights "the Renewable Integration and Substation of the Future projects, which are especially interesting for this market as well as the services that R&D Nester can provide such as laboratory testing, renewable production forecasting tools and storage management, among others".

Photovoltaïca is organized by the Kingdom of Morocco and aims to promote the renewable energy sector by joining in a single forum researchers, enterprises, service providers and other entities and national and international agencies in order to promote the development of the sector, particularly in the field of photovoltaic in Morocco and Africa. This year, Photovoltaïca had around 5000 visitors and 60 national and international exhibitors from Africa, Europe, America, and Asia. Portugal was the top participant in this edition with the biggest delegation, followed by the Italian, Spanish, and French delegations.





R&D NESTER AT CIGRÉ SESSION 46

The R&D Nester took part in the CIGRÉ (Conseil International des Grands Réseaux Électriques) Session, the biennial world forum for power system, held in Paris last August.

Nuno Pinho da Silva, researcher on renewable energy management at R&D Nester, presented the center's contribution based on the paper "Probabilistic dimensioning of tertiary control reserve driven by the intermittency of renewable generation in Portugal" at the group discussion of the Study Committee C2 - System Operation and Control. It addressed the dimensioning of operational reserves by accounting for the uncertainty of the wind and solar power production.

Nuno Souza e Silva, Managing Director of the R&D Nester, is the Portuguese regular member of the National Portuguese Committee to Study Committee C5 - Electricity Markets and Regulation. He is engaged in the activities of several working groups and the session was the opportunity to acknowledge the last developments and summarize the work from the last two years, as well as to set the agenda for the next years.

The session was attended by approximately 8000 people from 93 countries from all over the world, and it was a good opportunity for R&D Nester to highlight its skills and capabilities and network with potential partners.





R&D NESTER AS REGULAR MEMBER OF CIGRÉ STUDY COMMITTEE C5 - “ELECTRICITY MARKETS AND REGULATION”

Nuno Souza e Silva, from R&D Nester, was elected and nominated as Regular Member to the CIGRÉ (Conseil International des Grands Réseaux Électriques) C5 Study Committee that addresses “Electricity Markets and Regulation”, for the period 2016-2018, in representation of the Portuguese CIGRÉ National Committee. The nomination followed the recommendation from the Portuguese National Committee at the end of last year.

The Study Committee (SC) C5 scope is to analyze market approaches and solutions and their impact on the electric industry in support of regulators, traders, technology innovators and Independent Power producers as well as the traditional economists, planners and operators within the industry. The scope areas include:

- Consequences of regulatory changes for the electric power sector
- Regulatory incentives for investment
- System implications of new generation technologies
- Markets design's impact on transmission system operation
- Market design for integration of intermittent generation.

The SC C5 Working Groups (WGs) are:

- C5-16 Costs of Electric Service, Cost Allocation Methods, and Residential Rate Trends
- C5-17 Capacity markets: needs, solutions and state of affairs
- C5-18 Market price signals and regulated frameworks for regional coordination of grid investments.
- C5-19 Regulatory aspects of Demand Response and Demand Side Management for integration within Electricity Markets
- JWG C2 / C5-5 Development and Changes in the Business of System Operators
- SC C5 Strategic Advisory Group
- WG C5-10 Regulatory incentives for capital investments in electricity systems
- WG C5-11 Market Design for Large Scale Integration of Renewable Energy Sources and Demand-side Management
- WG C5-12 Market Power Mitigation
- WG C5-13 Interaction of Markets and Regulation Actions with Emerging Technologies
- WG C5-14 Regulatory Incentives for Innovation in Electricity Networks
- WG C5-15 Risk Management in Evolving Regulatory Frameworks
- WG C5-9 Retail Market Design - Customer Switching, Metering and Load Profiles.

The convener of SC C5 is currently Andy Ott, the President and CEO of PJM Interconnection.

Nuno Souza e Silva is currently the Managing Director of R&D Nester, was Country Manager of KEMA (now DNV-GL Energy) and his education includes the Florence School of Regulation “Regulation of Power Systems” 1-year program.



TECHNICAL INFORMATION



REAL TIME POWER SYSTEMS SIMULATION LABORATORY

R&D Nester - Centro de Investigação em Energia REN - State Grid S.A. owns a laboratory for real time simulation of power systems, which main assets are two real time power system simulators (RTPSS) acquired from two different manufacturers. To complement these two RTPSS, different hardware and software tools are also used, enabling the simulation of power systems and communication networks (either in a standalone mode or performing co-simulation).

Housing state-of-the-art equipment and different test tools it is possible to simulate different scenarios of power systems and assess their performance.

The introduction of digital solutions in power systems creates the opportunity for applications of new solutions and the Laboratory is also equipped with testing tools that allow a co-simulation of power system and communication networks. Different software and hardware solutions for simulation of communication networks running together with power systems simulation solutions offer this possibility. The vast range of simulation possibilities include Hardware-in-the-loop (HIL) techniques and in addition to the simulation in the Laboratory premises it is possible to have a remote access to some of its functionalities.

The large spectrum of tests that can be performed in the laboratory provide R&D Nester partners with knowledge and valid solutions under the scope of the different simulation possibilities. Testing of power systems and communication networks, including not only pure simulation environment but also HIL possibilities are great advantages for testing of new products and solutions. Grid operators can test the performance of their grids in real time the deployment of automation and protection devices using HIL techniques; Device manufacturers can verify their products functionalities operating in a close to real world environment, testing their product compliance, amongst many other possibilities.

REAL TIME POWER SYSTEMS SIMULATORS

The laboratory for real time simulation of power systems is based upon the existence of two RTPSS acquired from two different manufacturers. These two devices are complementary and their existence allows a wide range of applications in Power Systems simulation. Besides their main application on simulating power systems, the two RTPSS provide a very high computational power that can be used for other applications. This can be achieved by installing different software programs in the simulators, taking advantage of their great capabilities, both in terms of processing power and memory. A short description of both devices is now performed, highlighting the main characteristics of each one.

OP5600 SIMULATOR

One of the existing simulators is manufactured by OPAL-RT, a Canadian company which is one of the world leaders in the development of real time simulation devices and Hardware-in-the-Loop (HIL) testing equipment. The simulator at R&D NESTER laboratory has the following main characteristics:

- A 32-core UNIX based computer (OPAL OP5600) which is the main equipment responsible for running real time simulations. This server has a total of 64 Gb of RAM memory, which also allows the running of highly complex processes;
- Two expansion chassis (interfaces), each one providing a set of digital and analog inputs/outputs, which enables the execution of HIL tests. The total number of ports per chassis is: 16 Analog Outputs, 64 Digital Inputs and 64 Digital Outputs;
- Three different families of software: Hypersim, eMEGAsim and ePHASORsim, which have the capability to simulate large power networks (up to 2000 buses in EMT simulation using Hypersim or 10000 buses in electromechanical transient stability using ePHASORsim). eMEGAsim offers the user the possibility to simulate complex and fast transient responses such as power electronics converters and control systems. It allows a minimum time step of 10 μ s, whereas Hypersim has a typical time step of 50 μ s and ePHASORsim has a time step of 10 ms;
- The simulator has the ability to communicate using different protocols, including IEC61850 and is aware of different protocols such as PTP for time synchronization; for the IEC 61850 communication, there are 16 RJ45 ports at the expansion chassis.

ADPSS - ADVANCED DIGITAL POWER SYSTEM SIMULATOR

ADPSS is the first simulator worldwide that can perform real time simulation of large scale complex AC/DC power systems with up to 3000 generators and 30000 buses. This RTPSS is developed by China Electric Power Research Institute (CEPRI). The hardware solution existing at R&D NESTER facilities has the following main characteristics:

- Three high performance computing clusters, with 20 cores each (complemented by 32 Gb of RAM each), performing a total of 60 cores for real time simulation purposes. These three real time servers run in a UNIX platform designed for real time applications and are connected through a high speed InfiniBand (40 Gbit) network;
- A physical interface box, which provides the user a total of 48 Analog Outputs, 160 Digital Inputs and 160 Digital Outputs, for HIL testing;
- A digital interface box, specially designed for IEC 61850 applications, providing four interface cards, two for Sampled Values and two for GOOSE messages. Each card has a total of 6 optical outputs allowing a direct connection to Intelligent Electronic Devices (IED's);
- Two different software families: PSASP for electromechanical transient stability simulations and ETSDAC/ADPSS that allows EMT simulations:
 - PSASP provide different power systems simulation modules to the user, allowing the simulation of: Load flow; Transient stability; Short-circuit; Optimal load flow and reactive power optimization; Static security analysis; Network loss analysis; Static and dynamic equivalence calculation; User-defined model and program interface; Direct stability calculation; Small signal stability analysis; Voltage stability analysis; Relay protection setting calculation; Linear/non-linear parameter optimization; Harmonic analysis; Distributed off-line computing platform; Power system risk evaluation system; Transient stability limit automatic solution; Load current anti-icing and de-icing measures.
 - ETSDAC can be used for: Analysis of power system fault; Analysis of transient overvoltage and overcurrent; Dynamic characteristic simulation of high-voltage direct current transmission system; Analysis of sub-synchronous oscillation phenomenon; Design of PSS or other control parameters; Design of high-voltage direct current transmission (HVDC) system and flexible alternating current transmission system (FACTS).
- Hybrid simulation of electromechanical and electromagnetic transient (ST-EMT Hybrid) is an important feature of ADPSS. Co-simulation of fast and slow timescale with different time steps can then be performed by applying ST-EMT Hybrid parallel simulation interface.



OTHER EQUIPMENT AND SOFTWARE

The existence of the two RTPSS with other auxiliary equipment and software build an integrated and powerful laboratory simulation and testing environment, which enables not only the simulation of different phenomena in Power Systems and in Communication Networks but also the testing of new products, and the verification and demonstration of new technologies as well. The different hardware/software tools that exist at the R&D NESTER laboratory are listed below:

- Power amplifiers
- Communication networks simulator and testing tools
- IEC61850 Specification, Configuration and Testing tools/equipment
- Time synchronization servers
- Communication infrastructure.

For further detailed information please visit <http://www.rdnester.com/pt-PT/lab/>.

R&D NESTER PARTICIPATES IN THE SUSCITY PROJECT

R&D Nester is a partner of the project 'SusCity: Urban data driven models for creative and resourceful urban transitions' under the MIT Portugal Program. Besides R&D Nester, SusCity involves several universities, institutes and national companies, being funded by FCT Fundação para a Ciência e Tecnologia, Ministério da Educação e Ciência and a large set of industrial partners.

Started in 2015 and with an expected duration of 3 years, SusCity is a research and development project of a technological nature which the main scientific area of study covers the topic of sustainable cities. SusCity focuses on several structural aspects in the transition towards future cities such as information and communication technology, water and waste management, mobility and smart grids. Through collection and processing of massive amounts of urban data the project aims to develop new tools and services to promote an efficient use of urban resources with reduced environmental impacts.

The participation of R&D Nester in the SusCity project is focused on its smart grids' dimension, together with partners such as INESC TEC and EDP Distribuição. In particular, the work developed will result in new tools for assessing the impact in power systems of an increased penetration of distributed energy resources (photovoltaics; electric vehicles and controllable loads) in more sustainable cities. New electricity market models will also be studied to allow the market participation of new agents (aggregators; flexible loads; renewable power plants), namely through bids of a probabilistic nature.



R&D NESTER PARTAKES IN THE ISSWINDEMO PROJECT

R&D Nester takes part in the ISSWINDemo project. The goal is to demonstrate the added value of applying remote sensing and global navigation satellite system to the supporting services for wind power industry. The project gained the support from the European Space Agency and joins the R&D Nester and the GMVIS SKYSOFT, from Portugal, the GMV Innovating Solutions from Poland, and the HERMESS and ECN, from The Netherlands.

The ISSWINDemo contains 7 pilot projects exploiting the integrated assimilation of space data from the Earth's remote sensing and the global navigation satellite system to build wind resource maps, wind and wave hindcast databases, as well as weather, ocean and wind power forecasting.

The R&D Nester contribution to the ISSWINDemo is to provide services' drivers in line with the requirements from the stakeholders, namely onshore/offshore wind park developers, financing organizations, construction and maintenance companies, wind park operators and grid operators (TSO / ISO).





EVENTS



9-12 Oct 2016

LJUBLJANA, SLOVENIA

[IEEE POWER & ENERGY SOCIETY INNOVATIVE SMART GRID TECHNOLOGIES EUROPE 2016 CONFERENCE](#)

12-14 Oct 2016

OTTAWA, CANADA

[2016 IEEE ELECTRICAL POWER AND ENERGY CONFERENCE "SMART GRID AND BEYOND: FUTURE OF THE INTEGRATED POWER SYSTEM"](#)

18-20 Oct 2016

AMSTERDAM

[IEC 61850 EUROPE 2016 MULTI-VENDOR MULTI-EDITION IEC 61850 - ARCHITECTURES TO SUPPORT THE SMART GRID](#)

14-16 Nov 2016

MEXICO CITY, MEXICO

[INTERNATIONAL COLLOQUIUM CIGRE MEXICO 2016 "BUILDING SMARTER SUBSTATIONS"](#)

14-17 Nov 2016

BARCELONA, SPAIN

[EUROPEAN UTILITY WEEK](#)

EERA First Annual Conference

24-25 November, Birmingham, UK

see +

EEM 2017 14th International Conference on the European Energy Market

6-9 June, Dresden, Germany

see +

12th IEEE PES PowerTech Conference, 2017

18-22 June, Manchester, UK

see +



LITERATURE REVIEW



R&D and Innovation

Funding Opportunities

Horizon 2020 - Call Updates

Nearly half a billion euro available for transport and energy research.

Three Horizon 2020 calls for project proposals open on 2/09/2016 in the areas of Mobility for Growth, Automated Road Transport and Competitive Low Carbon Energy. In total, €455.5 million will be available to applicants. The earliest deadline to apply is 5 January 2017; others follow in late January and February.

Funding opportunities for Competitive Low-Carbon Energy

Applicants can submit their project proposals under nine topics in the area of renewable energy sources, smart grids and storage and decarbonisation of fossil fuels. The total call budget is €189.3 million.

More information on the call:

[Apply here](#)

Funding opportunities for Mobility for Growth

17 topics with a total budget of €216.2 million are open for research and innovation proposals in the fields of aviation, waterborne transport, road safety, green urban mobility, transport logistics and infrastructure, as well as research supporting policy making.

More information on the call:

[Apply here](#)

Source: European Commission, Horizon2020, INNOVATION AND NETWORKS EXECUTIVE AGENCY

Useful Platforms and Tools

European Investment Project Portal (EIPP) The meeting place for project promoters and investors!

Are you a project promoter based in the EU, and want to reach potential investors worldwide? Register your project in the [European Investment Project Portal \(EIPP\)](#) and boost its visibility to a large network of international investors! Start today by submitting your project below

Or are you an investor looking for investment opportunities in areas such as energy efficiency, transport, healthcare, renewable energy, broadband infrastructure or in financing SMEs? The European Investment Project Portal (EIPP) will offer you a broad choice of viable projects.

Source: European Commission, European Investment Project Portal

Energy and the Smart Specialisation Platform on Energy (S3PEnergy)

The [S3 Platform](#) Smart Specialisation Platform provides professional advice to EU countries and regions for the design and implementation of their research and innovation strategies for smart specialisation (RIS3). Services include:

- Provide guidance material and good practice examples
- Conduct high quality research projects to inform strategy formation and policy-making
- Facilitate peer-reviews and mutual learning
- Support access to relevant data
- Train policy-makers
- Organise information sessions for policy-makers and present at conferences

Source: European Commission, Joint Research Centre

Eurostat Sankey diagrams tool

Sankey diagrams for energy balance

This article describes the [Eurostat Sankey diagrams tool](#) published on the Eurostat website to visualise energy balances. Sankey diagrams provide an overview of the main energy flows and how they contribute to the global energy balance of a certain territory. This article also describes the main features of the Eurostat online Sankey tool and provides instructions on how to use the different menus and available options.

Source: Eurostat



LINKS



- [American Energy Innovation Council \(AEIC\)](#)
- [Associação de Energias Renováveis \(APREN\)](#)
- [China Electric Power Research Institute \(CEPRI\)](#)
- [Electric power research institute \(EPRI\)](#)
- [Energy Research Center of the Netherlands \(ECN\)](#)
- [European Energy Research Alliance \(EERA\)](#)
- [European Network of Transmission System Operators for Electricity \(ENTSO-E\)](#)
- [Programa Operacional Competitividade e Internacionalização \(COMPETE 2020\)](#)
- [COTEC Portugal](#)
- [The European Wind Energy Association \(EWEA\)](#)
- [Horizon 2020](#)
- [Laboratório Nacional de Energia e Geologia \(LNEG\)](#)
- [Nordic Energy Research](#)
- [Polo de Competitividade e Tecnologia da Energia \(EnergyIn\)](#)
- [Redes Energéticas Nacionais \(REN\)](#)
- [State Grid Corporation of China \(SGCC\)](#)
- [World Wind Energy Association \(WWEA\)](#)
- [Portugal 2020](#)
- [Agência Nacional de Inovação](#)



QUIZ



1) IN MAY 2016 PORTUGAL ENERGY CONSUMPTION WAS SATISFIED 100% BY RENEWABLES ENERGY SOURCES FOR HOW MANY DAYS?

- ☐ A) 1 day
- ☐ B) 3 days
- ☐ C) 0 days, that is impossible!
- ☐ D) 4 days

2) WHICH COUNTRY HAS THE HIGHEST INSTALLED POWER CAPACITY?

- ☐ A) United States of America
- ☐ B) Japan
- ☐ C) China
- ☐ D) Australia

4) FROM JANUARY 2016 UNTIL AUGUST 2016, IN PORTUGAL, HOW MUCH POWER DEMAND WAS FULFILLED BY RENEWABLES SOURCES?

3) THE BIGGEST PHOTOVOLTAIC POWER PLANT IN THE WORLD IS LOCATED IN ROSAMOND, CALIFORNIA USA. CAN YOU GUESS THE TOTAL INSTALLED CAPACITY?

- ☐ A) 525 MW
- ☐ B) 598 MW
- ☐ C) 579 MW
- ☐ D) 625 MW

5) THE RECORD FOR THE LABORATORY CONCENTRATED SOLAR CELL EFFICIENCY IS...

- ☐ A) 38%
- ☐ B) 43%
- ☐ C) 49%
- ☐ D) 46%

- ☐ A) 48%
- ☐ B) 59%
- ☐ C) 73%
- ☐ D) 67%

6) SINCE 2015 WHICH COUNTRY HAS THE BIGGEST INSTALLED PHOTOVOLTAIC POWER CAPACITY?

- ☐ A) Germany
- ☐ B) United States of America
- ☐ C) Spain
- ☐ D) China

Correct answers will be provided to you soon.
If you have problems answering this quiz, click [here](#) to answer this via browser.

Send

Answers of the 7th edition Quiz

1) In 2015, the electricity peak demand occurred at

Answer: A. January, 7th

3) In 2015, the electricity consumption was

Answer: B. 48 964 GWh

5) In 2015, the share of solar energy in the Portuguese electricity consumption supply was

Answer: B. 1.5%

2) In 2015, the electricity peak load was

Answer: C) 8 618 MW

4) In 2015, the share of wind energy in the Portuguese electricity consumption supply was

Answer: B) 23%

6) The first time wind power production exceeded the load demand in the Portuguese power system was at

Answer:

- (There was a typo in Q6)
- The correct answer is on December 28th 2015



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