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EDITORIAL



Dear Reader,

The Energy landscape, and electricity networks in particular, continue to undergo intense innovation and research and development activities in order to deliver the needed energy transition towards a sustainable energy system.

That sustainability implies guaranteeing a system managed in an efficient manner, able to deploy the conditions for the required reliability and security of supply, while ensuring an environmental friendly system.

It is in that context that we bring you in the Highlights section of this edition two of the R&D Nester efforts in that direction.

One relates to R&D Nester efforts to develop system-aiding tools that allow for an increasing integration of renewable energy sources while maintaining the robustness of the system and simultaneously performing it in an efficient manner with benefits to all energy system stakeholders.

A second one addresses the modernization of the network infrastructure, namely substations, in order to benefit from an improved deployment and management of the assets under exploitation and thus bring benefits for the energy system.

In the Technical Information, we offer you updated information on ongoing storage projects aimed at grid and system operation support, a view on how the Internet of Things is entering also the energy landscape, a revolutionary approach to capture energy from wind and some regulatory challenges in the road ahead as per the European Electricity Regulatory Forum.

As in the previous edition, this section is also enriched with some interesting links and curiosities. Also don't forget to test your knowledge with our popular section "Quiz", this time dedicated to very appropriate seasonal hot topic: solar energy!

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. Please continue to share with us your feedback!

Sincerely,

Nuno de Souza e Silva
General Manager



HIGHLIGHTS



RR&D Nester to complement solar forecasting tool with a sky camera

The R&D Nester is committed to improve and develop the existing solar power forecasting tool, which currently provides forecasts up to 7 days ahead; since photovoltaic (PV) electricity is an intermittent energy source, very short-term forecasts (up to 30 minutes ahead) are crucial to predict future cloud patterns in the vicinity of the solar generation facilities. Accurate forecasts are necessary to optimize real-time grid power management, to eventually manage PV electricity storage and to prevent non-interconnected regions network from a load shedding. Although cloud satellite observations do not offer sufficient space and time resolution to study intra-hour irradiance variability, all-sky cameras track the cloud cover evolution from the ground providing pertinent information for such forecasts [1].

Solar forecasting based on whole sky imagery analysis consists of four components [2]: a) acquisition of a sky image in the vicinity of the forecast site using a device such as sky camera; b) analysis of sky image data to identify clouds; c) estimation of cloud motion vectors using successive images; d) use of cloud location and motion vector data for short-term deterministic or probabilistic cloud cover, irradiance, and power forecasting.

Researchers at the University of California San Diego as well as at Reuniwatt have been publishing several pioneer studies in this field study, which involved using sky imagers specifically developed for solar forecasting applications and feature high resolution, high dynamic range, high stability imaging chips that enable cloud shadow mapping. (See [3] and [4] for their latest research publications)

R&D Nester has acquired a new generation All-sky camera with some unique features to make clear full hemispheric pictures of the sky even under full sun light conditions with particularly interesting features for photovoltaic evaluation applications. Since clouds and aerosols substantially contribute to the attenuation of solar irradiance at ground level, the sky imager provides quantitative data of the sky conditions on site. The cloud camera can also be used to monitor the solar position and detect potential shading obstacles at a PV site.

With these developments R&D Nester expects to contribute to an increasingly sustainable electrical network and system management, benefiting the whole electrical system.

References

- ¹ Ntche N., Trombe P.-J., Cros S., Using cloud fraction derived from all-sky camera to improve beam solar irradiance forecasting by time-series modelling, 14th European Meteorological Society (EMS) Annual Meeting & 10th European Conference on Applied Climatology (ECAC), October 6 -10 2014, Prague, Czech Republic.
- ² International Energy Agency (IEA) (2013). Photovoltaic and Solar Forecasting: State of the Art. Photovoltaic Power Systems Programme. Report IEA PVPS T14-01:2013
- ³ <http://solar.ucsd.edu/c/publications/>
- ⁴ <http://reuniwatt.com/en/publications/>

R&D Nester Project - 'Substation of the Future'

The goal of the 'Substation of the Future' project being developed by R&D Nester is to define and write the technical specifications for the next generation of the transmission substation secondary system, to be used by transmission system operators (TSOs).

In a substation, there are the primary and secondary systems. The primary comprises the high voltage equipment, such as transformers, circuit breakers and isolating switches. These devices are placed in the switchyard, and are the most visible part of the substation. But these devices need to be controlled, so there is the secondary system, also known as the PAC (protection, automation and control) system. The main components of the secondary system are the IEDs (intelligent electronic devices), interconnected by a communication network.

This Project deals with the secondary system only. It is a three-year project, which roadmap is depicted in the following picture.



The first deliverable of the project was a Vision document, a reflection on the 'Smart Substation' concept. The goal was to obtain a high-level description of what shall be the Substation of the Future. Some of the identified features among national and international stakeholders were:

- enable a total cost optimization and efficiency;
- make substations easier to operate and repair, safer and more secure;
- integrate new functionalities;
- extensively apply self-diagnosis, self-monitoring and self-healing capabilities.

The next step, the definition of a Reference Guide, was more technical, but did not enter into implementation details. Its purpose was to collect as many as possible requirements for the Smart Substation. For that, several departments inside TSOs were asked about what they wanted from a Smart Substation. Involved areas were, among others:

- control and automation;
- protection;
- metering;
- dispatch;
- project and construction of substations;
- asset management;
- information and communication technologies.

The project is currently in its second year, and the current tasks are the development of the **System Design** and the deployment of the **simulation center**.

The System Design is a set of **technical specifications** for the secondary system of substations, with the corresponding **test protocols**. The following aspects will be addressed:

- function definition;
- secondary system architecture;
- functional integration;
- redundancy;
- physical layout;
- acommunication network.

The **simulation center** that is being constructed will allow, in the third year of the project, to do the testing for the respective proof-of-concept of the designed system. This infrastructure is being intended to be used, not only for the 'Substation of the Future', but also for future projects. It will be equipped with the following main hardware and software pieces:

- Real time power system simulators - This will be installed to enable closed-loop tests of the secondary system, that is, the control and protection IEDs will be connected, via hardwired and Ethernet connections, to the RTPSS, that will be configured to simulate the power system;
- Time servers - A redundant time server will be installed, distributing time synchronization signals, not only to the simulation center equipment, but also to the IEDs under test. This time server will be driven by a GPS signal, having several time synchronization protocols as outputs;
- Communication network and time synchronization testing equipment - The communication network testing equipment will be used to test the influence of the communication network topology and traffic on the performance of the PAC functions;
- IEC 61850 specification and configuration tool - In order to exploit the benefits of the protocol IEC 61850, a third-party specification and configuration tool will be used in the project, in two steps; first to do the PAC system specification, then to configure the IEDs;
- IEC 61850 model and communication test software - This software will allow to ensure that both model and communication services between IEDs are in accordance to the IEC 61850 international standard.

This research and the corresponding infrastructure will contribute to a modernized network infrastructure with all the associated benefits to the different stakeholders and to guarantee the robustness of the electrical network under increasingly challenging conditions, thus benefiting the whole energy system and its stakeholders.



Energy Storage for grid reliability and frequency regulation

Renewable Energy Systems Americas Inc. (RES), one of the top renewable energy companies in North America, is currently developing two storage systems which together will comprise one of the largest energy storage deployments in North America. It is anticipated that this battery storage technology, when combined with proven PV solar technology, can provide significant benefits to power grids.

The projects, intended to provide energy storage over the course of a decade, will provide frequency regulation service to support grid efficiency.

“As the value of energy storage for grid reliability gains recognition nationwide, projects like the two being developed by RES are playing a growing role by better leveraging existing utility assets,” says the Project Manager. “The ability of energy storage to support grid efficiency through frequency regulation is another important benefit because storage is capable of ramping up and down generation assets within milliseconds.

RES is constructing the two 19.8 megawatt (MW) energy storage systems, each able to store 7.8 megawatt-hours (MWh) of energy. RES anticipates completing construction on the Jake Energy Storage Center in Joliet, IL, and the Elwood Energy Storage Center in West Chicago, IL, in the third quarter of 2015.

IEC White Paper on Wireless Sensor Networks

A new white paper by an international team surveys the role of wireless sensor networks in the evolution of the Internet of Things (IoT). The report catalogs current needs for underlying standards and infrastructure that must be met before wireless devices can become, as some envision, nearly as plentiful as dust.

Published by the International Electrotechnical Commission (IEC), Internet of Things: Wireless Sensor Networks* was prepared by a team led by Shu Yinbiao, of the State Grid Corporation of China, and Kang Lee, an engineer at the National Institute of Standards and Technology (NIST).

Wireless sensor networks have been called a digital skin. They are self-organizing networks of distributed devices – or nodes – that work cooperatively to gather and transmit information from the surrounding environment, be it a factory, electric grid, field-monitoring site, intelligent transportation system, or virtually any other setting. In addition to sensing the environment, these networks also may handle some control functions, such as adjusting building thermostats, redirecting traffic flows in a city, or optimizing manufacturing processes in a factory.

The IoT is a broader technological concept that embodies wireless sensor networks. As envisioned, the IoT would embed miniature computers in all manner of objects, from the most sophisticated, such as aircraft, to the mundane, such as clothing and appliances. Each object would be uniquely identifiable and linked through an Internet-like structure.

Cisco Systems estimates that the numbers of devices connected to the Internet will double to 50 billion by 2020.

The new IEC white paper discusses evolution of wireless sensor networks within the wider context of the IoT, describes the characteristics of wireless sensor networks and current applications and trends, and surveys future applications and the obstacles that stand in the way. It also assesses needs for standards to achieve interoperability among wireless sensor networks from different vendors and across varied applications.

Given the growing number of uses of wireless sensor networks, it's not surprising that many different standards organizations address various aspects of the technology, often in isolation. The white paper calls on standards organizations to improve communication and coordination, make unified plans, optimize resource allocation, and reduce duplicative efforts.

It also recommends increasing research devoted to improving network performance and quality of service, developing a systems architecture and integration technologies to accommodate diverse networks, developing a common model for ensuring security, and improving access technologies to conserve wireless spectrum and to support larger networks.

“We hope this paper will be a useful resource for a large and diverse community of stakeholders,” says Lee. “It provides a much-needed, high-level perspective on the technology’s vast potential and on the standards-related tasks that must be accomplished so that we can realize it.”

Source: <http://www.nist.gov/el/isd/iec-white-paper.cfm>

A wind generator without blades

Spanish startup Vortex Bladeless has developed turbines that harness vorticity, the spinning motion of air or other fluids. When wind passes one of the cylindrical turbines, it shears off the downwind side of the cylinder in a spinning whirlpool or vortex. That vortex then exerts force on the cylinder, causing it to vibrate. The kinetic energy of the oscillating cylinder is converted to electricity through a linear generator similar to those used to harness wave energy.

David Yáñez, one of the company’s cofounders, first came across the concept as a student studying the collapse of the Tacoma Narrows Bridge in Washington. The bridge collapsed in 1940 due to excessive vibrations formed by the spinning motion of wind as it blew past the bridge and is a textbook engineering failure. Yáñez, however, learned a different lesson. “This is a very good way to transmit energy from a fluid to a structure,” he says.

Vortex’s lightweight cylinder design has no gears or bearings. The oscillating turbine design will sweep a smaller area than a conventional blade turbine resulting in a 30% less efficient conversion. But Yáñez says it will generate electricity for 40 percent less than the cost of power from conventional wind turbines which will outweigh the losses.



Source: <http://www.technologyreview.com/news/537721/bladeless-wind-turbines-may-offer-more-form-than-function/>

Future challenges at the European Electricity Regulatory Forum

The European Electricity Regulatory Forum convened in Florence, 4-5 June, for its 28th Meeting.

The conclusions of the last meeting of this Forum, meeting once or twice a year, highlighted the following aspects in what concerns the future of electrical regulation:

1. On Network Codes and Guidelines:

“[...]the need to focus on the transformation from early implementation to implementation of legally binding requirements once each network code and guideline has been adopted. In particular, it calls for timely and consistent implementation across the Union and for this to be an on-going priority, with the full involvement of stakeholder committees based on the terms of reference proposed by ACER and ENTSOE. [...]”

2. On Implementation:

“[...]The Forum stresses that hedging instruments in forward energy markets are vital for risk management and must be fully financially firm to qualify as a perfect hedge. It recognizes that transmission rights can only be classified as fully financially firm if curtailment leads to compensation based on a calculation of the contemporaneous market spread. The balance of risk that market participants and tariff payers should take should be harmonized and determined by regulatory authorities [...]”

3. On Flexibility:

“[...]The Forum emphasises the growing importance of flexible demand and supply in energy markets as the share of variable generation sources grows. It stresses the need for the energy market to properly value flexibility and encourages the Commission in its market design initiative to focus on improving the efficiency of markets so that price signals encourage the development and deployment of the different sources of flexibility needed in different market timeframes, especially intraday and balancing. [...]”

[...] The Forum notes the growing number of sources of flexibility, including new technologies and market products that have the potential to offer cost-effective solutions to upcoming challenges, for example electricity storage. It emphasizes the need to remove barriers to their deployment, and also the need for new innovations. [...]”

The full document with conclusions is available here:

http://ec.europa.eu/energy/sites/ener/files/documents/Conclusions_Final_FF_June2015.pdf



LEGISLATION AND CURIOSITIES



LEGISLATION

Electricity

Despacho n.º 7/2015

Quarterly update of the reference rate of cogeneration (2nd quarter 2015).

[Read Document](#)

Decreto-Lei n.º 68-A/2015, de 30 de Abril

Establish provisions on energy efficiency and cogeneration production, transposing Directive No. 2012/27 / of the European Parliament and the Council of 25 October 2012, on energy efficiency.

[Read Document](#)

Resolução do Conselho de Ministros n.º 28/2015, de 30 de Abril

Approves the Commitment to Green Growth.

[Read Document](#)

CURIOSITIES

Vice-President Šefčovič on Energy Union Tour to Lisbon

As part of the [Energy Union Tour](#), Vice-President Šefčovič visited Lisbon on 2 July. During his visit, the Vice-President will discuss with a host of national actors and stakeholders the benefits of the Energy Union for Portugal and the challenges ahead. His visit included meetings with Prime Minister Pedro Passos Coelho, with Minister of Environment, Spatial Planning and Energy, Jorge Moreira da Silva, a joint hearing with parliamentary committees at the National Parliament, a meeting

with industrial representatives, as well as think tanks, civil society organisations active in the Energy Union field, students and other citizens with whom he discussed and debated in the framework of an Energy Union dialogue.

CSee the Vice-President Šefčovič BLOG POST about this visit [The Portuguese Age of Discovery.](#)

R&D and Innovation Information

Expanding our Network....

- R&D Nester becomes Associated Member of COTEC
- R&D Nester, Partner with INDEG-IUL for a new Executive Master

R&D Nester, Centro de Investigação em Energia REN - State Grid, S.A., associate member of COTEC since June

On 11 June, took place the annual general meeting of COTEC Portugal - Business Association for innovation, chaired by the President of the Republic of Portugal. In the agenda was the election of the new Associative Bodies for the next three-year period from 2015-2018 as well as the official admission of new members, including R&D Nester.

As a result of this partnership, R&D Nester has already sponsored one of the initiatives launched by Cotec : "Portugal, Country of Engineering Excellence" Award

R&D Nester is one of the COTEC associates that has given its support to the "Portugal, Country of Engineering Excellence" Award. This award was set up by COTEC Portugal and its associates, in partnership with the Portuguese Ministry of Education and Science. It seeks to encourage people to take up engineering and science in general, in Portugal. It is awarded to pupils and schools that have undertaken significant work in the engineering and technology fields.

The award comprises three €20,000 prizes for engineering activities in schools with a high percentage of experimental content. There are two sections to the award: one for pupils and the teachers who guide them in their work; the other for the school that presents the best pedagogical processes for teaching the experimental or laboratory component of the third stage of basic education.

The public launch of the award was held in the Calouste Gulbenkian Foundation on 11 June as part of the COTEC general assembly. The Portuguese President, Aníbal Cavaco Silva, was present, together with Nuno Crato, Minister of Education and Science, João Bento, Chairman of COTEC Portugal, Daniel Bessa, COTEC Portugal Director-General, and Eduardo Marçal Grilo, chairman of the jury.

According to Nuno Souza e Silva, R&D Nester's CEO who also attended the event, "R&D Nester's association with this award reinforces the importance that this Centre gives to innovation, to excellence and to the skills of human resources, for the enhancement of our country."

More information available on www.premioengenharia.pt.

R&D Nester partner with INDEG-IUL for Executive Master - Management with Specialization in Innovation Management

The R&D Nester and INDEG-IUL | ISCTE Executive Education (INDEG) entered into a strategic partnership agreement in the context of specialization in Innovation Management of the new executive master's degree in INDEG-IUL | ISCTE Executive Education.

Apart from R&D Nester, this course has 3 additional strategic partners: Siemens, Vortal and CTT. These strategic partners are a reference in innovation management, and represent different economic activities, leading to increased interaction between the academic and the business practice, optimizing the quality of executive education and contributing to the disclosure of cases and business innovation management processes.

More information available on <http://indeg.iscte-iul.pt/programa/InnovationManagement>.



EVENTS



26-28 AUG
2015

MILANO, ITALY

[INTERNATIONAL
WORKSHOP CIGRE 2015](#)

24-25 SEP
2015

BUDAPEST, HUNGARY

[THE 10TH DEREGULATED
ELECTRICITY MARKET
ISSUES IN SOUTH-
EASTERN EUROPE
\(DEMSEE 2015\)](#)

20-22 OCT
2015

BRUSSELS, BELGIUM

[14TH WIND INTEGRATION
WORKSHOP](#)

15-16 OCT
2015

MAASTRICHT,
NETHERLANDS

[FUNDING POSSIBILITIES
FOR ENERGY EFFICIENCY
PROJECTS](#)

17-20 Nov
2015

PARIS, FRANCE

[EWEA 2015 ANNUAL
EVENT](#)

SGTech Europe 2015

22 to 24 September, 6 to 28 August, Novotel Amsterdam City, Netherlands

see +



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 \(ENTSO-E\)](#)
- [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 \(WWEA\)](#)

FUNDING Opportunities

EU budget - A Beginner's Guide to EU Funding

Small companies (SMEs), non-governmental organisations (NGOs), young people, researchers, farmers, public bodies and other categories can benefit from this guide.

With references to websites about EU funding opportunities, available for the period 2014-2020, this guide provides basic information, especially on: i) how & where to apply, ii) other general rules (eligibility, etc.).

http://ec.europa.eu/budget/funding/index_en

http://ec.europa.eu/budget/funding/index_pt



QUIZ



1) SOLAR RESOURCE IS NOW A MAJOR SOURCE OF ENERGY FOR PRODUCING OVER 1 % OF ELECTRICITY AT A GLOBAL LEVEL. BY THE END OF 2014, WHAT WAS THE TOTAL WORLDWIDE INSTALLED CAPACITY OF PV?

- ☐ A) 253 GW
- ☐ B) 177 GW
- ☐ C) 103 GW
- ☐ D) 75 GW

3) WHICH OF THE FOLLOWING IS NOT A PHOTOVOLTAIC CELL TECHNOLOGY OF THIN-FILM TYPE?

- ☐ A) Amorphous Silicon (a-Si)
- ☐ B) Copper Indium Gallium Selenide (CIGS)
- ☐ C) Cadmium Telluride (CdTe)
- ☐ D) Polycrystalline Silicon (poly-Si)

5) INVERTERS PLAY A KEY ROLE IN THE SOLAR ENERGY CONVERSION CHAIN, BEING USED FOR DIFFERENT PURPOSES. WHICH OF THE FOLLOWING IS NOT A MAJOR CAPABILITY OF COMMERCIALY AVAILABLE PV INVERTERS?

- ☐ A) Maximum Power Point Tracking (MPPT)
- ☐ B) D.C. to A.C power conversion
- ☐ C) Active power generation
- ☐ D) Grid support and power control

2) WHICH OF THE FOLLOWING COUNTRIES HAS THE HIGHEST WORLDWIDE PV INSTALLED CAPACITY?

- ☐ A) USA
- ☐ B) China
- ☐ C) Japan
- ☐ D) Germany

4) TEMPERATURE AND IRRADIANCE ARE TWO MAJOR VARIABLES INFLUENCING THE OUTPUT POWER OF A PV POWER PLANT. IN WHICH CONDITION PHOTOVOLTAIC CELLS PRODUCE MORE ENERGY?

- ☐ A) High temperature and low irradiance
- ☐ B) Low temperature and high irradiance
- ☐ C) High temperature and high irradiance
- ☐ D) Low temperature and low irradiance

6) OVER THE PAST YEARS TECHNOLOGY ADVANCES HAVE ALLOWED A SIGNIFICANT OVERALL REDUCTION OF ENERGY LOSSES IN PV SYSTEMS. BEST PV RESEARCH-CELL EFFICIENCY IS NOW AROUND 46 %, WHAT ABOUT PV INVERTERS' EFFICIENCY LEVELS?

- ☐ A) PV inverters' efficiency is approximately 95 % to 99 %.
- ☐ B) PV inverters' efficiency is approximately 50 % to 55 %.
- ☐ C) PV inverters' efficiency is approximately 30 % to 35 %.
- ☐ D) PV inverters' efficiency is approximately 25 % to 30 %.

If you have problems answering this quiz, click [here](#) to answer this via browser.

Correct answers will be provided to you soon.

send

Answers of the 3rd edition Quiz

1) Usually, a substation is divided into:

Answer: B) Bays - 100% voters

3) In a substation, we can find:

2) Which from the following exists in a substation?

Correct: D) Switchyard - 100% voters

4) IED is an abbreviation for:

Answer: C) Both primary and secondary systems - 100% voters

5) PAC stands for:

Answer: A) Protection, automation and control - 100% voters

7) Which of the following is a communication service defined by the IEC 61850?

Answer: C) GOOSE - 75% voters

9) You are reading a document about engineering process defined by the IEC 61850 and see the abbreviation SCL. What does it mean?

Answer: D) Substation configuration language - 88% voters

Answer: C) Intelligent electronic device - 88% voters

6) What is the IEC 61850?

Answer: B) A standard defining communication networks and systems for power utility automation - 100% voters

8) Which of the following is a fundamental concept of the IEC 61850?

Answer: A) Logical Node - 25% voters

10) How many pages the first edition of the IEC 61850 approximately had?

Answer: C) 1000 - 75% voters



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LEGISLATION
QUIZ

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