R&D NESTER

16 NL nov 2019

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EDITORIAL | HIGHLIGHTS | TECHNICAL INFORMATION | LITERATURE REVIEW | EVENTS | LINKS | QUIZ - This specific Quiz deals with concepts related to substations. The definitions have been taken from www.electropedia.org

EDITORIAL

Editorial 16th



Dear Reader,

Earlier this month, the World Energy Council highlighted several issues facing the energy transition in Europe in the publication "2019: The World's Energy Agenda & its Evolution". These include, among other issues, Digitalization, Electric Storage and Market Design. Indeed, digitalization is seen as key to optimize operations and enhance efficiency, storage is a key resource to maximize efficiency and flexibility, supporting the integration of more variable renewables and incorporation of electric vehicles, and market design remains an action priority for the European TSOs, with special concerns around the integration of variable renewables and the development of capacity markets. These address also the challenging balance of Energy Security, Energy Equity and Environmental Sustainability of Energy Systems.

It is in this context that R&D Nester is developing its work around European projects such as FlexPlan and INTERPRETER, related to the development of advanced tools and methodologies for planning and operation of grid infrastructure. The demonstration of novel solutions addressing storage, flexibility and market design is being pursued by R&D Nester also via its participation in the Flexitranstore project, where the development of a new adaptive Power System Stabilizer (PSS) model that allows damping of low frequency oscillations of the system in a more effective way through the use of new techniques for network behavior prediction in the context of high share of renewable generation is explored.

The need for an improved TSO-DSO cooperation is being addressed in the European project INTERRFACE, where the team in which R&D Nester participates just published a state-of-the-art paper on "Analysis on Existing Tools and Services for Grid and Market Stakeholders and Requirements to Improve TSO/DSO Coordination".

Moving towards an efficient digital communications infrastructure is an important element in the above mentioned energy transition, and the use of IP solutions for protection purposes was explored by R&D Nester with very promising results.

Still on the digitalization related topics, it is worth highlighting the conclusion of the European project Big Data Ocean, addressing the management and exploitation of big data repositories, for different purposes but also including energy applications. It is one of the largest maritime data repository with more than 150 TB of maritime related data.

Finally, the hot topic of solar power generation continues to be addressed, namely with the ongoing quest to improve forecast capabilities against a background where this type of generation is taking a growing share of total power system generation and consumption, making it a key element for energy security and for an environmental friendly system.

You can read about these new developments and more in the pages below.

Sincerely,

Nuno de Souza e Silva
Managing Director

HIGHLIGHTS

R&D Nester and REN win FlexPlan, new H2020 Project on “Advanced Methodologies and Tools”

R&D Nester and REN won an H2020 project, submitted to the Call ES-6 related to "Research on Advanced Tools and technological development", in particular to the topic "Advanced tools for the design and planning and operation of electricity grid infrastructure including distribution and transmission level (...)".

In this new project, R&D Nester and REN are part of a consortium with 11 other partners from Italy, Serbia, Slovenia, Belgium, Norway, Spain and Germany. The project team includes several research and development institutes and grid operators (3 TSO and 1 DSO).

The project is entitled "FlexPlan" and aims at "creating a new tool for optimizing transmission and distribution grid planning, considering the placement of flexibility elements as an alternative to traditional grid planning", while "taking into account environmental impact and carbon footprint".

R&D Nester participates in all (8) Work Packages and will be responsible for WP5 - "Regional Cases and assessment of advantages", where the planning tool will be tested using six different regional cases in Europe. Additionally, R&D Nester also has a strong contribution to WP4 - "Pan-European scenarios at target years", being the partner responsible for collecting and harmonizing data necessary to the creation of Pan-European and regional scenarios in three time horizons: 2030, 2040 and 2050.
REN has a contribution to the identification of data sources and data collection, and a focus on the development of one of the six regional cases focused in the Iberian Peninsula, besides contributing partially to other work packages.

The project started in October 2019, will last until September 2022 (36 months), and is financed by H2020 under the Grant Agreement 863819.
For more information: Project on R&D Nester website

R&D Nester wins INTERPRETER, new H2020 Project on “Storage and Flexibility”

Following the application that R&D Nester submitted to the European Commission with a project proposal to the Horizon2020 program, the project was approved.

R&D Nester is part of a consortium with other 8 partners from Spain, Belgium, Greece, Denmark and France, including 2 DSOs from Belgium and Spain.

The project is entitled "INTERPRETER" and the overall objective is, according to the Proposal approved, "to develop a modular grid management solution consisting of a set of interoperable off-line and on-line software tools for an optimized design, planning, operation and maintenance of the electricity grid that will be offered to grid operators through an open source software platform.

These tools will support DSOs and TSOs to move from a traditional grid management approach to an active system management approach, addressing the whole power system (i.e. both distribution and transmission level) and considering the rapid deployment of distributed energy resources (variable renewables and storage) as well as growing environmental concerns."

R&D Nester is responsible for one of the eight Work Packages, namely WP5 - "Software applications for an efficient grid planning", besides contributing partially to other Work Packages.

The work started in October 2019 and extend until the end of 2022 (36 months).

R&D Nester presented the paper “Survey Analysis on Existing Tools and Services for Grid and Market Stakeholders and Requirements to Improve TSO/DSO Coordination”

R&D Nester presented a survey entitled "Survey Analysis on Existing Tools and Services for Grid and Market Stakeholders and Requirements to Improve TSO/DSO Coordination". This survey was developed under INTERRFACE Project "TSO-DSO Consumer INTERFACE aRchitecture to provide innovative grid services for an efficient power system", financed in scope of the H2020 program.

The European project INTERRFACE main objectives are to design, develop and exploit the interoperability of a pan-European network service architecture to act as an interface between the TSO and DSO and customers; and to enable the integrated and coordinated operation of all stakeholders for the use and acquisition of common services. This is a 4-year project that lasts from January 2019 to December 2022. It counts with the participation of 42 partners, from 16 countries, where R&D NESTER, REN and EDP Distribuição are from Portugal.

This paper was presented at 5th edition of IEEE conference "ISSE 2019 - International Symposium on Systems Engineering", a symposium that seeks to create an interactive forum for the advancement of the practice of systems engineering across the multiple disciplines and specialty areas associated with the engineering of complex systems.



The paper presented focus on the results obtained through a survey about existing tools and services, carried out to identify the current European landscape from grid and market stakeholders' point of view and to improve the coordination between the Transmission System Operators (TSOs), Distribution System Operators (DSOs) and market participants'. The main conclusions of the survey analysis are related with the identification of current tools and services characteristics and also identify the needs and challenges foreseen in the future energy system. The outcomes of this survey will be key in the next phase of the project, where the service design and reference architecture design will be tackled, as well as for the implementation of the interfaces of these tools to the IEGSA platform*.

R&D Nester paper presentation stimulated the curiosity of the audience about this IESGA platform that will be developed within the project INTERRFACE and how this survey analysis and results will be used in the designing phase of the common architecture which will enable the connection, data and information exchange with existing data hubs across Europe, where TSOs, DSOs, market participants and customers are connected.

* Interoperable pan-European Grid Services Architecture to act as the interface between the power system (TSO and DSO) and the customers and allow the seamless and coordinated operation of all stakeholders to use and procure common services.

Conference website
Project on R&D Nester website

Developments in FLEXITRANSTORE European project

Recently, R&D NESTER hosted a meeting of the European project FLEXITRANSTORE.



This meeting took place in the context of the participation of R&D NESTER's team, which includes the researchers Ricardo Pastor and Nuno Amaro, in the tasks of the Work Package associated to one of the 8 demonstrators of the project - "Demo 8 - Advanced Control for flexible synchronous generation".

This demonstrator focuses on the development of a new adaptive Power System Stabilizer (PSS) model that allows damping of low frequency oscillations of the system in a more effective way through the use of new techniques for network behavior prediction in the context of high share of renewable generation. This demo will be validated in a real cogeneration (combined heat and power - CHP) power plant in Bulgaria.

R&D NESTER has a central role in this work package, since it will develop, both the network model of the area of influence of the power plant (part of the transmission network of the Bulgarian system), and one of the network behavior prediction models, which will be used for the tuning of the adaptive PSS.

R&D NESTER will make use of its Real-Time Power System Simulator (RTPSS) lab where it will develop the network model and the prediction algorithms, testing them as they were observing the real network.

Several project partners involved in this work package participated in the meeting, including Schneider Electric (Spain), Loyola (Spain) and Chalmers (Sweden) Universities, and the manufacturer of signal acquisition and analysis systems STER (Croatia).

In last August, R&D Nester also participated in the International Symposium on High Voltage Engineering - ISH 2019 Conference, where the project FLEXITRANSTORE was particularly highlighted.



The conference organized a special session dedicated to the FLEXITRANSTORE project, in which several articles prepared within the scope of the project's work were presented aimed at the dissemination of the results obtained so far within the scientific and industrial community present at the conference.

R&D NESTER participated in the elaboration of 3 articles that were presented during the conference.
The project meeting is part of the set of periodic meetings that allows to monitor the progress of the project as a whole and where the various partners present their latest developments as well as the planning for the next tasks.

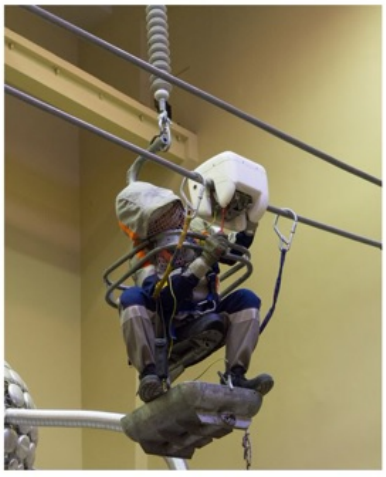
R&D NESTER's team, which is led by researcher Ricardo Pastor, presented the work done by the team for one of the Work Packages in which R&D NESTER participates associated with one of the 8 demonstrators of the project - "Demo 8 - Advanced Control for flexible synchronous generation", mentioned above.



R&D NESTER presented the dynamic model of part of the Bulgarian transmission system developed in partnership with the Bulgarian TSO (ESO) which will be used as a basis for the development of the network behavior prediction models that will be used for the tuning of the adaptive PSS.
For this purpose, R&D NESTER used its real-time power system simulation laboratory (RTPSS-Lab) where it is developing network models and prediction algorithms that will be tested almost as if they were interacting with the real network.

The meeting was attended by partners from the entire consortium.





For more information:
Project website
Conference website
Project on RDNester website
R&D Nester Lab on website

Protections over IP/MPLS Prot.MPLS project ‘Open day’



The Prot.MPLS project, developed under the scope of a partnership between REN and R&D Nester, aimed to assess the possibility of using REN's IP/MPLS communication network for line protection and teleprotection functions.
In this project, the SDH (synchronous digital hierarchy) network, the solution used today for this purpose, was used as baseline to measure the results obtained with the IP/MPLS network, by means of a comparison between these two scenarios. The project had a multidisciplinary team with elements from the Operation and Maintenance Division (ELEX), the IT Projects Management Division (PRGP) and R&D Nester.

The need for this study was because the SDH technology is becoming obsolete, with manufacturers focusing their efforts on IP-based networks.

However, the latter type of network has no deterministic character, that is, the transmission time of the information is not known in advance, fact that could jeopardize the correct functioning of the mentioned protection functions.
However, the results of the tests, performed at the R&D Nester laboratory and using REN's communications infrastructure, proved that REN could, migrate in the future, the services related to the protection functions from the SDH to the IP/MPLS network, without any limitations.

To divulge this project, including the main conclusions reached by the team, a session, called 'Open day', was held at the R&D Nester laboratory, led by João Caseiro, meant for at colleagues who, being functionally close to this topic, had no still knowledge of the developed work.

In addition to the project team, members of the mentioned Divisions were present, having also the opportunity of attending to some of the tests performed during the project.



Developments in BigDataOcean European project

R&D Nester participated in the European Maritime Day 2019 (EMD19), with the main goal of presenting the results of the project BigDataOcean. This conference is an official event from the European Commission, which this year took place in Lisbon, and had more than 1500 participants from industry, academia and national and European authorities.



During the two days event, R&D Nester was one of the 105 exhibitors present at the conference, with a stand dedicated to BigDataOcean. The participation allowed the project team of R&D Nester to present the results obtained in this H2020 project, focusing in the presentation of the Big Data platform developed in the project and the use case related to the assessment of wave energy potential.



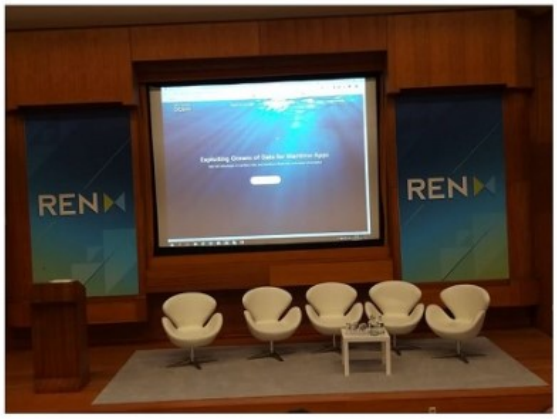
Additionally, R&D Nester also participated in a workshop organized in EMD19 dedicated to the presentation of Big Data Artificial Intelligence and digitalization for maritime applications. In this workshop, R&D Nester presented the BigDataOcean project and participated in a panel discussion with the main goal of providing insight on how these techniques can be used in multiple maritime sectors and what is the added value from used them. Results of this workshop include the creation of a set of recommendations to be provided to the European Commission, aiming at increasing the usage of these techniques in a sill rather traditional but with a high potential sector.

Nuno Amaro, researcher from R&D Nester, together with Rui Lopes, from UNINOVA, partner of the REN and State Grid R&D Center, presented the main results achieved in this European project, focusing in the BigDataOcean Platform, which became in the last two and a half years, in one of the largest maritime data repository. According to the R&D researcher, "it is expected that the quantity and variety of data continues to raise now that the platform is publicly available to all users".



It's more than 150 TB of maritime related data that the BigDataOcean platform hosts, since its development began in January 2017, and that R&D Nester presented in its headquarter in a workshop under the scope of the Project BigDataOcean.





This project, integrated in the EU Framework Programme for Research and Development Horizon 2020 (H2020), has been developed by a multidisciplinary European consortium and with the contribution of ENONDAS. The consortium has partners from Greece, United Kingdom, Germany, Italy and Portugal, in addition to R&D Nester.

With a life platform demonstration, Nuno Amaro briefly introduced the data currently existing and the platform potential, in addition to the four use cases currently implemented, focusing in the wave energy use case. As described in the presentation, the platform, which was developed mainly by three of the consortium partners (National Technical University of Athens, Ubitech (software house) and University of Bonn), has stored oceanographic / weather-related data (e.g. wave, wind, biology), IAS data (georeferenced and vessel navigation data), vessel operational data, and other georeferenced data (e.g. protected areas, location and characteristics of ports, among other).

The presentation was also focused in the wave power assessment pilot, which has been the main activity developed by R&D Nester in the project, with the collaboration of ENONDAS. This service has two main goals: the evaluation of wave energy potential, in locations or areas selected by the user and the evaluation of the potential for conversion into electric power considering wave energy converters. The services are created by correlating data with wave characteristics from multiple sources (numerical models, buoys, satellite) and allow platform users a significate time reduction while performing these studies, assuring the quality of obtained results.

The workshop was open to the general public and several external entities were represented, including DGPM (Portuguese Directorate-General for Maritime Policy), ISQ, LNEG, and multiple research centers related to offshore energy, among others.

For more information:
European Maritime Day website
Project on R&D Nester website
BigDataOcean Workshop

China's Minister of Science and Technology visits R&D Nester



The Minister of Science and Technology of China, Mr. Wang Zhigang, and Minister of Science, Technology and Higher Education of Portugal, Mr. Manuel Heitor, visited R&D Nester.

R&D Nester received delegations from the Secretary of State for Energy, the Embassy of the People's Republic of China in Portugal and CEPRI, namely its

President, Mr. Zhao Peng, and the executive committee of REN.

The ministerial and CEPRI delegations also showed particular interest in visiting the R&D Nester laboratory.

This visit is part of the 9th Joint Commission Sino-Portuguese for Science and Technology, also with the presence of the Ministers of Portugal and China and where R&D Nester was invited to make a presentation.

The reason for this visit is that R&D Nester is an example of success and good cooperation between the two countries. Good perspectives for the future cooperation between Portugal and China regarding Science and Technology!

For Nuno Souza e Silva, Managing Director of R&D Nester, who made the presentations in both days, "it was an honor to receive these distinguished delegations. The projects developed with the shareholders, the extensive participation in European activities and the various acknowledgements that R&D Nester has received are elements that we think value not only R&D Nester, but also the shareholders and cooperation Portugal-China".








R&D Nester promotes Summer Internships



R&D Nester hosted this year 4 summer internships: 1 trainee from ISEL - Instituto Superior de Engenharia de Lisboa and 3 trainees, students of IST - Instituto Superior Técnico.

This type of initiative allows these students to know the reality of the sector dealing with real projects and customers. In addition, these students end up acquiring more in-depth knowledge of the many concepts of the electricity and energy sector in general that until then only knew in theory. This experience seeks to reconcile the theoretical and abstract knowledge these students acquired in their course, bridging the reality experienced in R&D Nester and the decisions that are associated to energy sector in general.

The context of R&D Nester is particularly suitable for this type of initiatives, as it provides them to work in Research, Development and Innovation area, often close to the student's study areas and already with a connection to applications in business life.

These internships lasted between 4 and 8 weeks. This is intended to be an enriching experience to remember and to boost the professional career of these 4 potential young researchers.

These were the Trainees for last summer at R&D Nester:

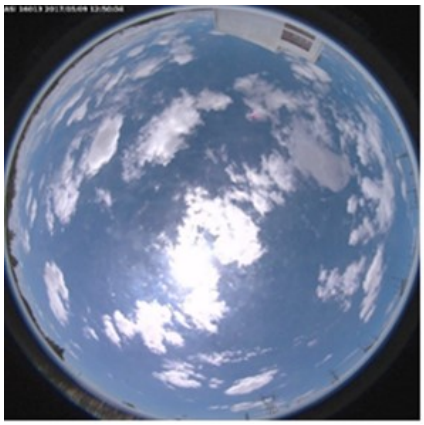
- Adrião Ribeiro Júnior, postgraduate degree in engineering and renewable energy management, at ISEL - Instituto Superior de Engenharia de Lisboa
- Maria Leonor Mina, MSc in Electrical Engineering and informatics at IST - Instituto Superior Técnico
- José Correia, MSc in Mechanical engineering at IST - Instituto Superior Técnico
- Luiz Silveira, MSc in engineering and Energy management at IST - Instituto Superior Técnico.

The Trainees worked on themes such as solar energy forecasting, modelling and simulation of real-time power systems and Machine Learning Techniques for energy forecasting.

TECHNICAL INFORMATION

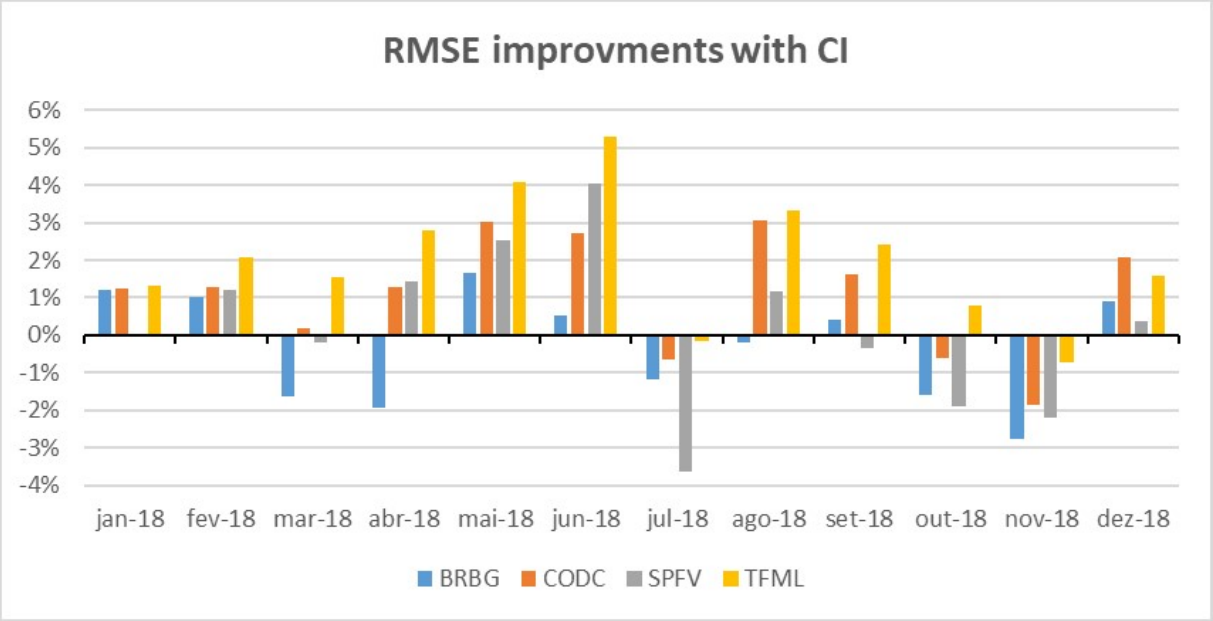
SKY OBSERVATION – COMPARISON OF METHODOLOGIES

R&D NESTER have a sky camera installed in a REN substation close to a solar photovoltaic power plant, collecting pictures of the sky every five minutes. With this, one can have a short-term representation of the amount of clouds in the sky. The clouds influence significantly the power generated by a solar power plant by reducing or increasing the amount of solar radiation that reaches the solar panels. Typically, the mesoscale forecasts are updated every 6 hours and these estimations are based on statistical or hybrid models. With the use of a local measurement as the pictures of the sky, one can update the forecasts in short-term.





In this article, four cloud indexes are presented. Two of them, BRBG and CDOC, are provided by the sky camera itself and are well known in the literature. The other two cloud indexes, SPFV and TFML, were fully developed by R&D Nester research engineers. To compare these cloud indexes, the power forecast of the full year of 2018 was redone applying each cloud index. In the figure bellow, the results are shown, representing the improvement in the root mean square error (RMSE) for each month comparing with the case without cloud index.



Analyzing the results, one can see that the cloud indexes developed by R&D NESTER (SPFV and TFML) are showing the best results. However, between this two the TFML have the best performance. The improvements can reach about 5%, which significantly improves the solar forecast.

In this methodology, to apply the cloud index to the solar forecast, only the last available sample of the cloud index was applied. In the future studies, a statistical combination of several past cloud index samples are going to be applied to the solar power in order to reach higher improvements.

LITERATURE REVIEW

The World's Energy Agenda & its evolution - issues monitor 2019, World Energy Council

This report takes a focused look at the issues facing the energy transition in Europe, using data collected by surveying over 40 leaders and shapers representing the European Transmission and Distributors Operators.

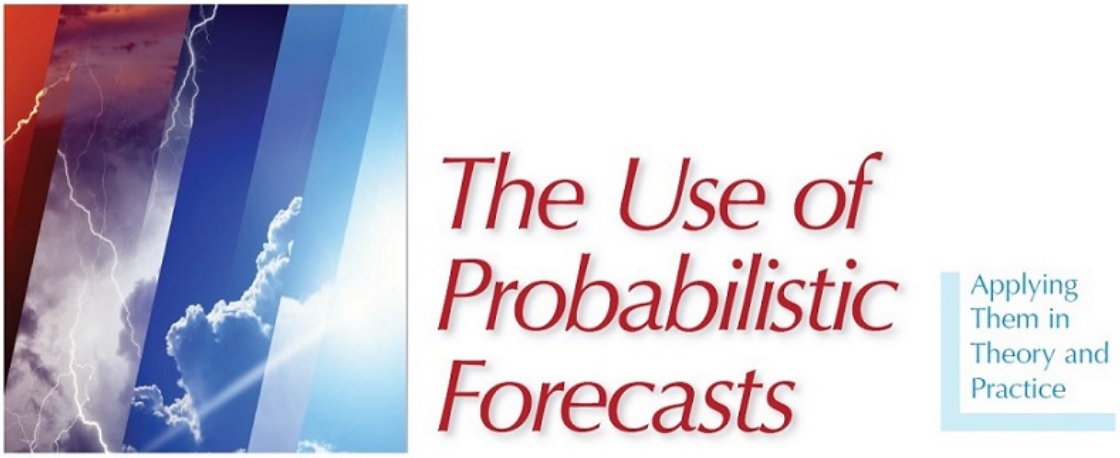


Papers presented by R&D Nester during this Summer

NAME OF THE DOCUMENT	EVENT	DATE
"The Use of Probabilistic Forecasts	IEEE Power and Energy Magazine (Issue of November/December 2019)	Oct/2019
"Survey Analysis on Existing Tools and Services for Grid and Market Stakeholders and Requirements to Improve TSO/DSO Coordination"	IEEE 2019 5th IEEE International Symposium on Systems Engineering Edinburgh, Scotland, UK	Oct/2019
"ETIP-SNET Vision 2050 - Integrating Smart Networks for the Energy Transition"	CIRED 25th International Conference on Electricity Distribution Madrid, Espanha	Sep/2019
"TDX-ASSIST: Beyond State of Art in TSO-DSO Interoperability - The Portuguese Demonstrator"	CIRED 25th International Conference on Electricity Distribution Madrid, Espanha	Sep/2019
"Synchrophasor based monitoring system for grid interactive energy storage system control"	ISH 2019 Conference International Symposium on High Voltage Engineering Budapeste, Hungria	Aug/2019
"Zero Renewable Incentive Analysis for Flexibility Study of a Grid"	ISH 2019 Conference International Symposium on High Voltage Engineering Budapeste, Hungria	Aug/2019
"Conflict of Interests between SPC-Based BESS and UFLS scheme frequency responses"	ISH 2019 Conference International Symposium on High Voltage Engineering Budapeste, Hungria	Aug/2019
"The Current Status and Experience of Renewable Energy Development in Portugal"	Chinese Control and Decision Conference (CCDC) 2019 Nanchang, China	Jun/2019
"Study on the Demand and Requirements of Renewable Energy Primary Frequency Control"	Chinese Control and Decision Conference (CCDC) 2019 Nanchang, China	Jun/2019
"Fostering Offshore Wind generation through grid nodal capacity calculation".	WESC 2019 Wind Energy Science Conference (European Academy of Wind Energy) Cork, Irlanda	Jun/2019

R&D Nester publish article in IEEE Power & Energy Magazine

R&D NESTER participated in the production of the article entitled "The Use of Probabilistic Forecasts- Applying Them in Theory and Practice", published in the November/December 2019 issue of IEEE Power & Energy Magazine.



This article addresses the advantages of probabilistic prediction in relation to traditional deterministic prediction. This 12-page article has eleven co-authors and was led by meteorology expert Sue Ellen Haupt, from U.S. National Center for Atmospheric Research (NCAR), with the collaboration of TSO/ISO (REE, ERCOT, CAISO) companies of market operators (AEMO), SPP), research and development operators (Fraunhofer IEE, Energy & Meteo Systems, WEPROG, UL-AWS Truepower and R&D NESTER), from various geographies (North America, Europe and Australia).

The article starts by indicating the four existing methodologies to generate probabilistic predictions: 1) statistical methods of probabilistic forecasts, 2) statistically based scenarios, 3) physically based ensemble forecasts, 4) perturbation-based ensemble forecasts.

Describing several examples of application by end users:

- Using Probabilistic Information as Input for Grid Security Calculations: A German Example,
- Using Probabilistic Information to Fine-Tune Unit Commitment: A Lesson From the U.S. SPP,
- Capturing Extreme Conditions: A Lesson From the Electric Reliability Council of Texas,
- Use of Probabilistic Forecasting for Extreme Events, Such as High-Speed Shutdown Risk Assessment: An Irish Case,
- Use of Probabilistic Forecasts by the TSO: A Spanish Case.

IEEE Power & Energy Magazine website

New industry report - Digitalization and the future of energy

Publication available here



EVENTS

12 -14 Nov 2019

PARIS, FRANCA

EUROPEAN UTILITY WEEK INITIATE!

12 -13 Nov 2019

AMSTERDAM, THE NETHERLANDS

R&D INNOVATION CONFERENCE

27 -29 Nov 2019

PRAGUE, CZECH REPUBLIC

11TH ANNUAL EUROPEAN POWER STRATEGY & SYSTEMS SUMMIT & POWER PROJECT FINANCING AND NEW TECHNOLOGIES FORUM

28 -28 Nov 2019

LISBON, PORTUGAL

PORTUGAL RENEWABLE SUMMIT 2019 (APREN CONFERENCE)

4 -5 Dec 2019

WINDHOEK, NAMIBIA

RENPOWER SOUTHERN AFRICA INVESTORS 2019 THE RENEWABLE ENERGY, OFF-GRID AND POWER INFRASTRUCTURE INVESTORS CONFERENCE

21 -23 Jan 2020

AMSTERDAM, THE NETHERLANDS

SMART GRID FORUMS - COMMON INFORMATION MODEL 2020 DEMONSTRATING THE FULL VALUE OF CIM TO SECURE INVESTMENT AND SPEED UP WIDE-SCALE IMPLEMENTATION

LINKS

Some useful links:
ON RESEARCH, DEVELOPMENT AND INNOVATION

Portugal:

- Portugal 2020
- Portal da Inovação
- Agência para o Desenvolvimento e Coesão (AdC)
- Agência Nacional de Inovação (ANI)

Europe:

- COTEC Portugal
- Portugal in Europe Research and Innovation Network (PERIN)
- European Energy Research Alliance (EERA)
- Direção-Geral de Estatísticas da Educação e Ciência (DGEEC)
- BRIDGE (H2020)
- Horizon Europe
- ETIP SNET - European Technology and Innovation Platform Smart Networks for Energy Transition

Rest of the World:

- Horizon 2020
- BlueInvest
- EIT InnoEnergy

OTHER ENTITIES

Portugal:

- Energy, Climate Change, Environment | European Commission
- Research and Innovation | European Commission
- Eurostat - Science, Technology and Innovation

Europe:

- Funding, Tenders | European Commission
- China Electric Power Research Institute (CEPRI)
- EU-GCC Clean Energy Technology Network

Rest of the World:

- Laboratório Nacional de Energia e Geologia (LNEG)

QUIZ - This specific Quiz deals with concepts related to substations. The definitions have been taken from www.electropedia.org

1) WHICH IS THE WORLD LARGEST BATTERY SYSTEM BEING USED IN A POWER GRID?

- a)10 MW
- b)30 MW
- c)100 MW
- d)200 MW

2) WHAT IS THE WORLDWIDE COMBINED UTILITY-SCALE AND BEHIND-THE-METER INSTALLED STORAGE CAPACITY BY THE END OF 2018?

- a)<1 GW
- b)Between 1 and 2 GW
- c)Between 2 and 3 GW
- d)>3 GW

3) WHAT IS THE SPLIT OF WORLDWIDE SPLIT BETWEEN UTILITY-SCALE AND BEHIND-THE-METER INSTALLED STORAGE CAPACITY BY THE END OF 2018?

- a)Utility-scale 10%; behind-the-meter 90%
- b)Utility-scale 40%; behind-the-meter 60%
- c)Utility-scale 50%; behind-the-meter 50%
- d)Utility-scale 75%; behind-the-meter 25%

4) WHICH ARE THE 5 MAIN SOURCES OF ELECTRICITY PRODUCTION IN THE WORLD BY THE END OF 2017 (FROM 1ST TO 5TH)?

- a)Coal, Natural Gas, Nuclear, Hydro, Wind
- b)Coal, Natural Gas, Hydro, Nuclear, Wind
- c)Natural Gas, Coal, Nuclear, Hydro, Wind
- d)Natural Gas, Coal, Nuclear, Wind, Hydro

5) WHAT IS THE TOTAL NUMBER OF ELECTRIC CARS WORLDWIDE IN THE END OF 2018?

- a)< 1 Million
- b)Between 1 and 3 million
- c)Between 3 and 5 million
- d)> 5 Million

6) THE GLOBAL EV FLEET CONSUMED DURING 2018 AN ESTIMATED:

- a)< 30 TWh
- b)Between 30 and 50 TWh
- c)Between 50 and 80 TWh
- d)> 80 TWh

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

1. Answer: c)100 MW
2. Answer: d)>3 GW
3. Answer: b)Utility-scale 40%; behind-the-meter 60%
4. Answer: b)Coal, Natural Gas, Hydro, Nuclear, Wind
5. Answer: d)> 5 Million
6. Answer: c)Between 50 and 80 TWh

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Tel.: +351 21 001 13 00

Email: info@rdnester.com

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