R&D NESTER

23 NL mai 2022

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EDITORIAL

Dear Reader,

Flexibility management, Grid planning tools, Evolved system architecture, Grid use optimization, Grid stability and Use of analytics, are some of the core elements to the Energy Transition we are undergoing. In order to fulfill its' mission of Creating a Smart Energy Future, R&D Nester is developing work on these topics that we are sharing with you in this Newsletter.

Within the OSMOSE project we are modeling and quantifying the future of flexibility, and demonstrating flexibility of BESS, inverters, RES, industrial loads and the grid itself.

Grid planning is being addressed in projects INTERPRETER and FlexPlan, where we are considering tools that support TSOs and DSOs in the transition from "traditional" network management to a more active management, and holistic approaches toward planning of transmission and distribution networks.

Scalable architectures that allows the entire European electrical system to function as a unique system in which a variety of markets enable the universal participation of different stakeholders is being addressed in project OneNET.

In project FLEXITRANSTORE we work on Power System Stabilizers and detection of low-frequency oscillations.

Dynamic Line Rating is contributing to an optimized use of the grid assets and market functioning as we discuss in project OptiGrid.

Analytics, via Big Data, Machine Learning and AI techniques, is increasingly contributing to improve energy systems planning and operation, as we are being able to achieve results in projects BD4NRG and I-NERGY.

You can read about all these developments below in our "Highlights" section.

In the "Technical Information" section we elaborate on two very distinct hot topics: in one we discuss the use of Dynamic Programming Algorithms for fault detection; in another we present the standard for Use Cases, which is an increasingly used tool for representing and understanding energy system interactions.

The "Literature Review" section we bring you a vision into the future, with the Future Energy Scenarios with a timeframe of 2050 as viewed from the UK, a look into the past, with the Final Report on Power System Separation occurred in 24 July 2021, and a snapshot of the present, with the World Energy Issues that include the current views from CEOs, Ministers and experts.

As in the previous edition, this Newsletter is also enriched with some interesting links and curiosities. Also don't forget to test your knowledge 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.

Please continue to share with us your feedback!

Sincerely,

Nuno de Souza e Silva

Managing Director

HIGHLIGHTS

FINAL STAGE OF H2020 PROJECT OSMOSE AND ITS

RESULTS PRESENTATION



The European project OSMOSE (started in 2018 and ends in April 2022) has as its main objective the identification and development of the ideal combination of flexibilities for the European energy system, in order to allow a sustainable and secure energy transition.

OSMOSE

OPTIMAL SYSTEM-MIX OF FLEXIBILITY SOLUTIONS FOR EUROPEAN ELECTRICITY

R&D NESTER participated in the General Assembly of the European project **OSMOSE (Optimal System-Mix of Flexibility Solutions for European Electricity)** that was held last November in Lausanne, Switzerland.



R&D NESTER and REN had a very active participation in this project last period, having presented results of several tasks, namely:

- **T1.4 - Innovative flexibility options in the context of planning, operation and stability**, led by R&D NESTER and which also has the collaboration of REN and Italian ENSIEL. In this task, several studies were carried out on the flexibility of the European energy system in various contexts, from planning to operation, including dynamic stability studies for the 2030 and 2050 time horizons.
- **T7.1 - Interoperability**, where R&D NESTER collaborates and provides its Real-Time Power System Simulation Laboratory (RTPSS Lab) for the validation of an improved version of the engineering process defined in the IEC 61850 standard, using devices and tools from several manufacturers.
- **T7.2 - TSO-DSO coordination for efficient exploitation of flexibilities**, where R&D NESTER collaborated in the validation and testing of the **Flexibility Scheduler** tool developed.

R&D NESTER participated recently in the Final Conference of the OSMOSE project at RTE headquarters in Paris, France, where the results achieved by the project were presented.





The event was attended by representatives of the European Commission, the Agency for the Cooperation of Energy Regulators (ACER), the European Innovation and Technology Platform (ETIP-SNET) and Industry (Saft ESS Division) who joined in a round table discussion.



This final conference featured 3 sessions focused on the following topics:

- Modeling and quantifying the future of flexibility;
- Demonstrating BESS & inverters' flexibility;
- Demonstrating RES, industrial loads and grid flexibility.

These sessions included the presentation of activities in which R&D NESTER and REN were directly involved, including:

- Optimal mix of flexibility in long-term scenarios (Energy Storage Planning (DESPlan Tool, R&D NESTER), Flexibility and Reserves (PS-MORA, REN), Dynamic studies (ENSIEL));
- Optimization of voltage control on the TSO/DSO interface (Flexibility Scheduler, EFACEC, REN, R&D NESTER);
- Improvement of the engineering process based on the IEC 61850 standard (EFACEC, REN, R&D NESTER).





This final phase of this European OSMOSE project has several dissemination actions planned in its last months.

In this final meeting, a brochure was also presented with a summary of the project results (link) and a series of final webinars that would take place between April and May of this year. The last one was held last May 4th. These various webinars aimed to give visibility to the results of the activities developed, as well as to promote discussion through round tables where several experts of the project discussed the topics covered.

Final Webinar Series	
Demonstration of grid forming capabilities and synchronization services	05 April
Smart management of the grid exploiting line temperature and load forecasts	07 April
Demonstration of close-to-real-time cross border flexibility market	21 April
Demonstration of an innovative Hybrid Flexibility Device that provides multiple grid services	26 April
Optimal mix of flexibility in long-term scenarios	03 May
Market design modeling and analysis for flexibility	04 May

More information:

OSMOSE Project in R&D Nester website

OSMOSE Project website

OSMOSE Project Brochure

OSMOSE Final Conference presentations

R&D NESTER - PLANNING AND MANAGEMENT OF THE ELECTRICITY GRID: INTERPRETER H2020 PROJECT



INTERPRETER "Interoperable tools for an efficient management and effective planning of the electricity grid" is funded by the European Union under the H2020 programme and it counts with the participation of nine partners, including TSOs e DSOs, electrical companies and research

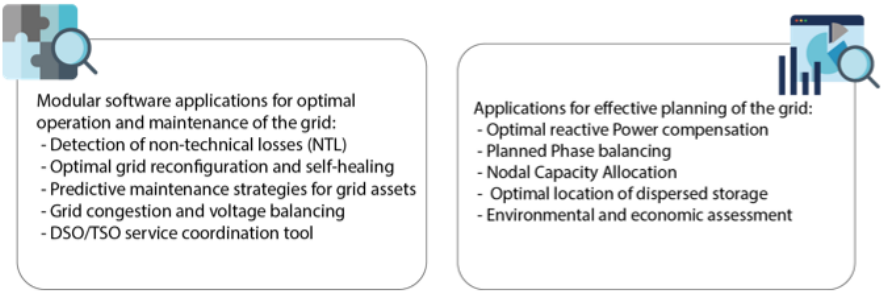
and development centres, with researchers joining forces to develop an ambitious solution, including the participation of R&D Nester R&D very focused on creating two applications for network planning.



INTERPRETER main objective is the implementation of a modular grid management solution consisting of a set of 10 software applications for an optimal design, planning, operation and maintenance of the electricity grid - with a special focus on the distribution network.

The various modules will be accessed by network operators through an interoperable platform.

These tools will support TSOs and DSOs in the transition from "traditional" network management to more active management, considering the rapid development of distributed energy sources as well as a growing concern for the environment.



R&D Nester is the Leader of Work Package 5 on "Software Applications for an effective grid planning".

This project started in October 2019 and is scheduled to end in October of this year.

The promotional video of the project was just released, check it here: INTERPRETER video



For more information:

INTERPRETER Project website

INTERPRETER Project @ R&D Nester website

LAUNCH OF ONENET PROJECT PROMOTIONAL VIDEO WHERE R&D NESTER AND REN ARE PARTNERS

OneNet (One Network for Europe) - "TSO-DSO Consumer: Large-scale demonstrations of innovative grid services through demand response, storage and small-scale (RES) generation" is a unprecedented project being the largest project founded by Horizon 2020 in the topic of integration and cooperation TSO-DSO-Consumer, involving 70 partners from different countries, of which REN and R&D Nester are part.

The purpose of this project is to create a fully replicable and scalable architecture that allows the entire European

electrical system to function as a unique system in which a variety of markets enable the universal participation of different stakeholders, regardless of their physical location - at all levels, from small consumers to large producers.

This project lasts for 3 years (October 2020 to September 2023).



The promotional video of the project has just been released: OneNet project video.



More information:

OneNet website

OneNet Project @ R&D Nester website

R&D NESTER PRESENTATION ON DYNAMIC LINE RATING AT THE IBERO-AMERICA CONFERENCE EVEX2021



R&D NESTER participated in the Ibero-America conference **Evex2021** (*Energy Virtual Experience 2021*), which was hold from December 6th to December 10th, with a presentation of an abstract entitled "*Aplicação do Dynamic Line Rating (DLR) para minimizar o Market Split no MIBEL*".

This presentation focused on sharing the results already obtained in the scope of the **OptiGrid** project, founded by FCT (*Fundação para a Ciência e Tecnologia*), in partnership with LNEG (*Laboratório Nacional de Energia e Geologia*).

This conference main topic was the Ibero-Americana energy transition in a world after COVID-19.



Besides the presentation made, a paper related with this topic is going to be published. This paper focused on the presentation of the results of three case studies, addressing wind power, solar power and Market Splitting, respectively. In the first case study, the North of Portugal was used in order to take into consideration all the wind power available.

The DLR was compared with the traditional approach, showing improvements in terms of line capacity. In the second case study, the South of Portugal was used in order to take into consideration all the solar power available. Similar results were obtained.

The results of these two case studies also suggested that in some cases, the limiting factor was not related to the power line capacity but was instead associated with other required technical constraints in the electrical network configuration.

The final case study, related with the market splitting, shown that the number of hours in which Market Splitting occurs was reduced with the application of the DLR.

For more information:

OptiGrid Project website

EVEx - Energy Virtual Experience

R&D NESTER PRESENTED A MODEL FOR POWER SYSTEM STABILIZER DEVELOPED IN THE FLEXITRANSTORE PROJECT AT THE CIGRÈ SEERC CONFERENCE



R&D NESTER participated in the conference **CIGRÈ South East European Regional Council (SEERC) 2021 - Vienna**, where it presented part of the work developed in **FLEXITRANSTORE** project.



R&D NESTER released the results of the work that has been developed in the project, namely regarding the creation of a model (grey-box model) that allows to identify and estimate low-frequency oscillations (LFOs) in electrical systems. This work was developed in partnership between R&D NESTER and other partners involved in

demonstrator 8 "Robust conventional generation plant through Power System Stabilizer". In this demonstrator, a method was developed to estimate potential LFOs that may arise in the electrical system and dynamically adjust the parameters of a PSS (Power System Stabilizer) of a generator, thus allowing the damping of this type of oscillations in a more effective and robust way. This work involved the development and validation of the model, considering several network scenarios.

This year, due to restrictions caused by the COVID-19 pandemic, this SEERC session took place in virtual format on the 30th of November, having only selected a set of 31 articles to be presented during the online event. The event included moments of interaction with the audience, with a period of questions and answers about each of the presentations.

FLEXITRANSTORE is a project funded by the European Commission under the Horizon 2020 program and has the participation of R&D NESTER as a member of the consortium.

Full project details are available at Flexitranstore project website and Flexitranstore Project information at R&D Nester website.

R&D NESTER PRESENTED FLEXPLAN REGIONAL CASES IN ISGT EUROPE CONFERENCE



R&D NESTER participated in a special session of the conference ISGT Europe 2021, dedicated to the presentation of the work developed in **FlexPlan** project.

ISGT Europe 2021
IEEE PES Innovative Smart Grid Technologies
18 - 21 October 2021, Espoo, Finland

FlexPlan - "Advanced methodology and tools taking advantage of storage and FLEXibility in transmission and distribution grid PLANning" 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. This approach aims at helping to reduce overall power system costs i.e. infrastructure deployment and operation costs, the latter in terms of procurement of energy and system services.

FlexPlan is a project financed by the European Commission in the framework of Horizon 2020 Programme, and includes R&D NESTER and REN as members of the consortium.

In this special session at **ISGT Europe 2021**, moderated by the FlexPlan coordinator, partners of the project performed five presentations to highlight the main developed solutions and their validation process. This session included as well a component of interaction with the audience in a panel discussion with questions and answers.

R&D Nester presented the main outcomes of the work developed so far in the project, including the creation of energy scenarios up to 2050 and the creation of network models to simulate these scenarios. This work has been developed by R&D Nester and the remaining partners involved in the creation and simulation of regional case studies at European level. These regional cases will be used to validate the grid-planning tool developed within the in project.

The work presented includes an analysis and data collection from multiple sources, creation and validation of both, energy scenarios and grid models to be used. The network models include transmission and distribution systems, using georeferenced information and a complete characterization of generation and load.

ISGT Europe is one of the main international conferences in the field of smart grids and this year happened in a virtual environment due to the international context related to covid19.

The full program of the conference can be accessed here.

All details about the project can be checked in FlexPlan Project website.

More information: FlexPlan Project @ R&D Nester website.

I-NERGY H2020 PROJECT "ARTIFICIAL INTELLIGENCE FOR ENERGY" WITH R&D NESTER LAUNCHES 1ST OPEN CALL FOR SMES AND START-UPS



The EU-funded **I-NERGY** project, focused on Artificial Intelligence applications for next generation Energy systems and integrated by R&D Nester, launched an Open call for projects.

This call for project is open to SMEs or Startups developing Artificial Intelligence algorithms and services applicable to the energy sector, targeting 6-month projects with a maximum funding of 50.000€.

All details of this open call and the form for applications are available here.

For more information:

I-NERGY Project website

I-NERGY Project @ R&D Nester website

R&D NESTER AND REN IN "BIG DATA FOR NEW GENERATION ENERGY" H2020 PROJECT BD4NRG: NEW DEVELOPMENTS



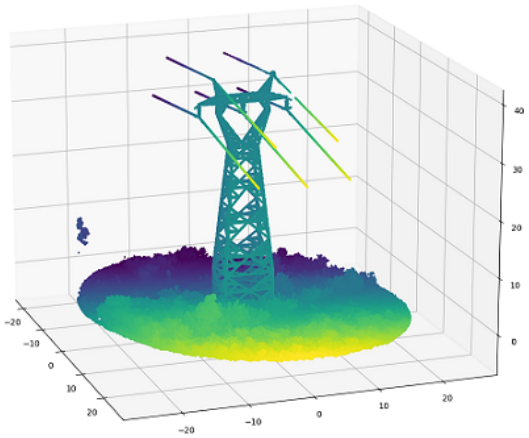
R&D Nester and **REN** integrate the project **BD4NRG - "Big Data for New Generation Energy"**, which started in January 1st 2021 under the EU funded H2020 program.

The main goal of **BD4NRG** is to address big data management and decision-making challenges in the energy sector using **state-of-the art data science and Artificial Intelligence techniques**. This project will therefore unlock new solutions for this sector which have never been explored in the past, giving energy stakeholders the opportunity to improve their operations and economic returns. From a technical standpoint, the BD4NRG ecosystem will make available a set of distributed data services, including big data processing and analytics tools as well as **Machine Learning and other AI based models**.

The technical solutions developed in the project will be validated through 12 large scale pilots across 10 countries.

R&D Nester, along with REN, is contributing with one of such pilots, focusing on the application of **AI solutions** to condition based monitoring and predictive maintenance for two classes of transmission system assets: overhead lines and circuit breakers.

Currently, R&D NESTER and REN are working in the development of the required algorithms to execute these data related pilots.



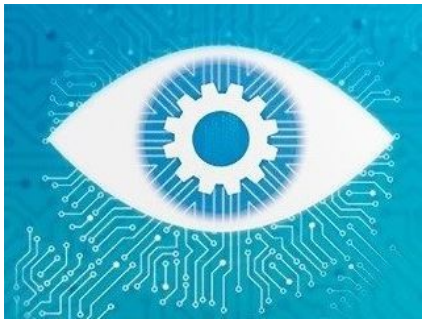
On September 2021, the first issue of **BD4NRG** newsletter was released, where more information on the scope of the project, the current status of developments and upcoming activities can be consulted.

More information:

BD4NRG Website

BD4NRG Project @ R&D Nester website

R&D NESTER REPRESENTED IN APDSI PANEL ON ARTIFICIAL INTELLIGENCE IN ENERGY INFRASTRUCTURES



R&D Nester was invited to participate in the **MeetOn** panel **"Artificial Intelligence in support of the country's critical infrastructure management, the case of energy"** which was organized by APDSI - Associação para a Promoção e Desenvolvimento da Sociedade da Informação.



The **MeetOn** launched the discussion on the role that Artificial Intelligence plays in transforming the information and knowledge society and more specifically in supporting the management of energy critical infrastructures, prompting speakers and assistance with questions such as "how this intelligence manifests itself , called artificial as opposed to biological intelligence in the animal kingdom? Where does it apply? Is it creative? How useful is it?" and contributing to the clarification through the analysis of the reasons underlying the use of Artificial Intelligence and the operational gains resulting from the adoption of this paradigm.

R&D Nester shared the application of its **AI.Forecasting** tool to national load forecasting, photovoltaic generation forecasting, regional load forecasting and generation (at medium voltage) and in the producer-consumer, namely in buildings, in which it obtained the **3rd place** in the **IEEE ODS competition on building energy consumption forecasting**, as well as the applications of satellite image processing to support the management of fuel lanes, are currently being studied in the **RESUCIDEMO** project, which has had the contribution of REN since its inception.

These examples show evidence of the adaptability and disruptive potential of Artificial Intelligence, and also that it needs help to be creative and useful, since it needs inputs that require human creativity and ingenuity to be efficient at finding actionable relationships and patterns.

APDSI is a non-profit, public utility and Non-Governmental Organization for Development (NGDO) that mobilizes individual and collective partners around causes oriented towards digital transformation, and wants to be recognized for its decisive contribution to the development of a an inclusive, participatory and secure information society, promoting economic and social development with an impact on all citizens.

R&D NESTER RENEWS THE CERTIFICATION IN RESEARCH, DEVELOPMENT AND INNOVATION



As a result of the External Audit conducted last October by APCER, **R&D Nester** renewed its **certification under Portuguese Standard 4457:2007 - Certification of Management Systems for Research, Development and Innovation (RDI)**.

It should be noted that R&D Nester has been a certified entity in RDI since 2015, having been the first entity in REN universe to obtain RDI certification, within the scope of Research, Development and Innovation Activities in solutions in the area of energy systems.

According to the Final Audit Report, the auditing entity concluded that "...the organisation demonstrated a robust Research, Development and Innovation Management System, based on three key processes: 1) Project Management, 2) Management of Interfaces and Knowledge and 3) Ideas Management.

Good practices in project management and respective control were highlighted, namely through project portfolio management, which translates into interesting financial results.

As strong points of the company and of the RDI management system, the following should be highlighted: i) the involvement of top management in the most relevant aspects of RDI management; ii) the focus on results and the effectiveness demonstrated; iii) the widespread culture of innovation..."

The R&D Nester team will remain committed to maintaining the **certified RDI Management System**, recognising the importance of following this normative reference and good practices in the management of R&D+I activities, aligned with the objectives and strategy of the organisation.

TECHNICAL INFORMATION

Fault Detection Using Pruned Dynamic Programming Algorithms

In the context of H2020 project **I-NERGY** [1], **R&D Nester** has been testing novel techniques for fault analysis and condition based monitoring strategies, using Circuit Breaker historical data.

One of the tools developed is an **advanced methodology for Fault Detection**, based on oscillography data. It proposes the usage Change Point Detection (CPD) algorithms, together with a set of signal processing and rule based decision processes, to implement a fully data-driven Fault Detection module, able to filter out fault records from other events.

Pruned Exact Linear Time (PELT) is an highly popular and efficient Dynamic Programming algorithm for CPD, introduced by Killick [2]. While many CPD methods are either fast but heuristic or exact but slow (e.g. Binary Partioning), pruned methods look to be both fast and exact [3]. The common approach for CPD is given by the optimization of the following problem:

$$min_{\tau,k} \sum_{j=0}^{k} C\left(\boldsymbol{y}_{\tau_j+1:\boldsymbol{y}_{\tau_{j+1}}}\right) + \beta$$

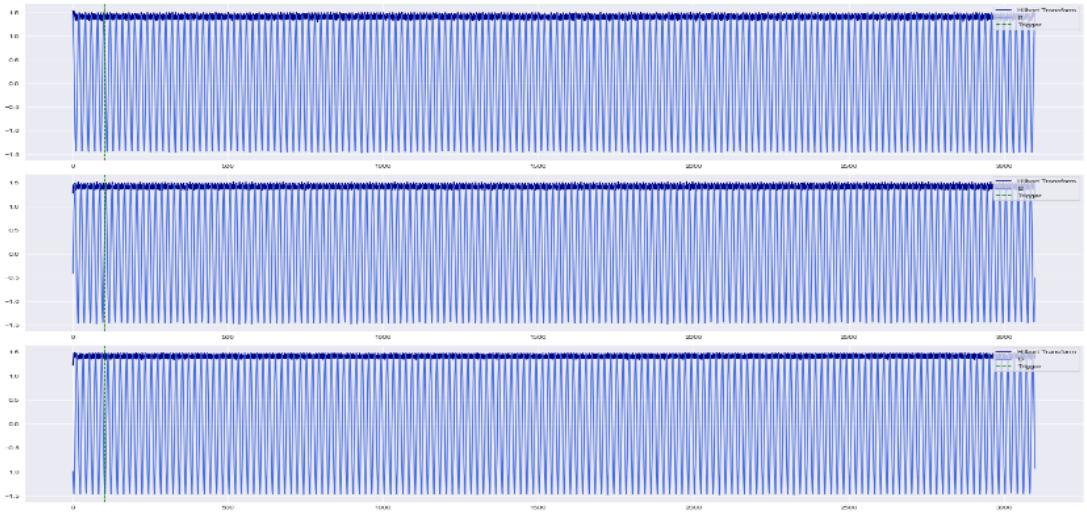
Where is the input signal, is the vector of changepoints, is the cost function for a segment and is the penalty against overfitting. Most exact approaches solve this problem using an iterative timestep approach, where previous timesteps are considered candidates for the previous changepoint to the current time [3]. Pruning increases the computational efficiency of this Optimal Partitioning approach (performing in assuming a linear distribution of changepoints), while ensuring that a global minimum is found. This is done by pruning the number of candidates at each iteration, assuming that when a changepoint is introduced, the cost necessarily reduces.

In the context of this work, PELT is applied to transformed versions of the analog channel data. Each of the time-series is standardized by mean and variance, and an approximation of the envelope is obtained by the application of the *Hilbert* Transform.

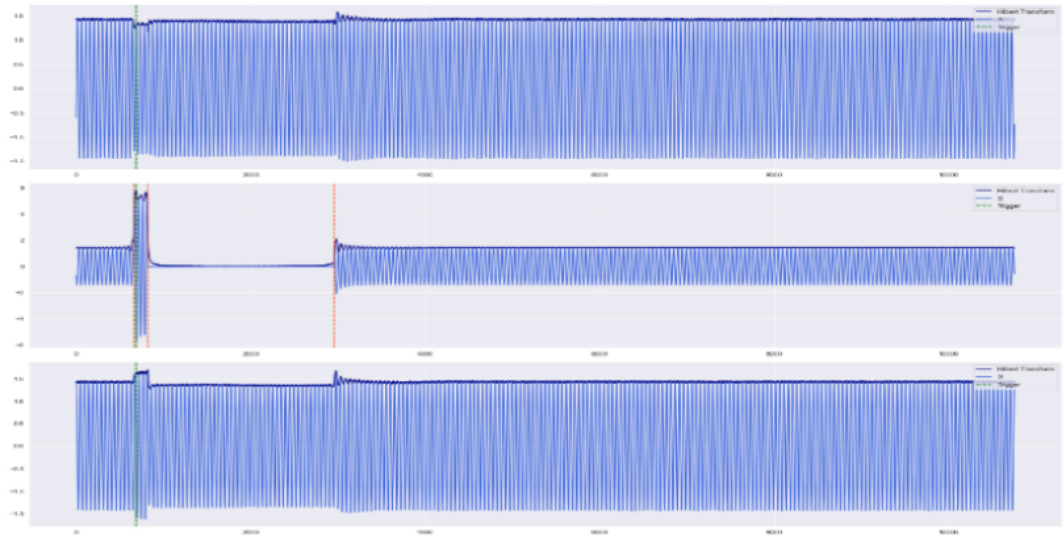
The system is designed to classify each COMTRADE files into 3 distinct scenarios, using the number of changepoints detected:

1. Normal operating conditions: triggered by software errors or misconfigured protection systems, these do not have any oscillographic event.

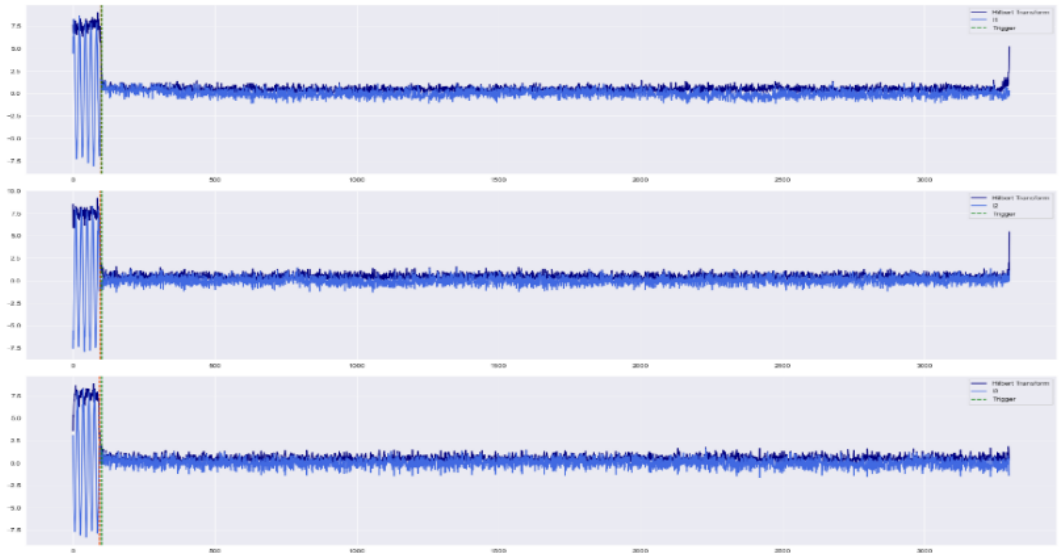
This scenario is associated to changepoint absence.



2. Fault: which represents a typical shunt fault, such as phase to ground fault. Typical scenarios include more than one changepoint in any of the input signals.



3. Planned Circuit Breaker opening: a standard maneuver, for maintenance purposes. The typical pattern, in these cases, are single occurrences of changepoints which are followed by absence of current.



The implemented methodology is integrated in the toolbox developed for the I-NERGY R&D NESTER pilot, where there historical event data must be sorted and faults should be separated from other tripping events.

References:

[1] I-NERGY Project Consortium. I-NERGY - Artificial Intelligence for Next Generation Energy. Online. Available at: https://i-nergy.eu/.

[2] Killick, Rebecca & Fearnhead, Paul & Eckley, I.A. (2012). Optimal Detection of Changepoints with a Linear Computational Cost. Journal of the American Statistical Association.

[3] Maidstone, R., Hocking, T., Rigaill, G. et al. (2017). On optimal multiple changepoint algo-rithms for large data. Stat Comput 27, 519-533. https://doi.org/10.1007/s11222-016-9636-3.

IEC 62559 - Use Case Methodology

The **IEC 62559** is a series of standards that is composed by three main parts. In general this standard defines a methodology for power systems domain experts to determine and describe their user requirements for automation systems, based on their utility business needs [1]. Increasingly these standards are being used in diverse European projects (**TDX-ASSIST**, **GIFT**, **ONENET**, etc.), which is a good way to ensure compatibility with standardization and European Union work in a comprehensive manner.

The standard allows the interoperability and is an efficient way to different stakeholders, projects and standardization bodies to take advantage of a common cooperation platform, including a collaboration framework. The possible applications of the standard are extensive from the energy to health sector.

In the specific case of the energy sector, the Use Case methodology is particularly appropriate for describing TSOs/DSOs services and business processes being helpful in the definition of new requirements and identification of new opportunities brought by smart grid technologies, markets development, or regulations, for example.

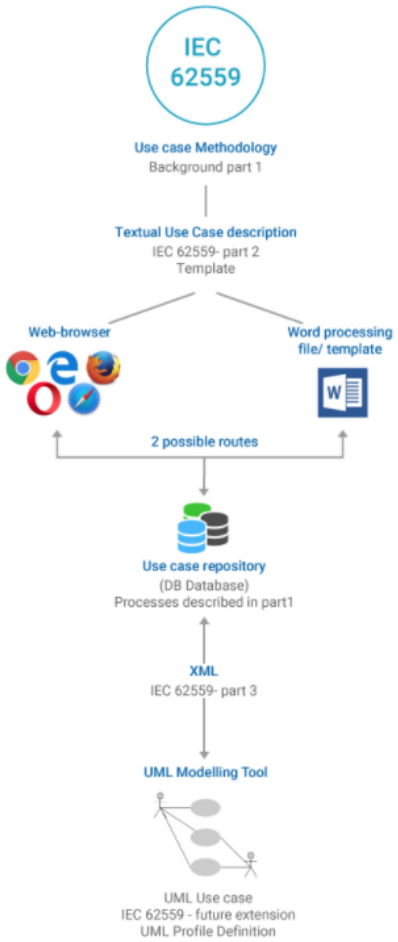


Figure 1 - IEC 62559 series of standards relationships [1]

The **Part I** of the standard is where the concept and processes in standardization are explored. It provides the foundation for a common use case management repository to bring together use cases in a common collaborative platform and defined in a uniformed template. The harmonization of use cases is key to provide widely accepted use cases that can work as basis for future work and expansion of the standardization works [1].

The **Part II** defines the use case template, actors list and requirements list. The template can roughly be divided in the following parts: General Information, Function, Technical Details, and Additional Information. These parts include the following sub-section: description of the use case, diagrams of the use case, technical details information, step-by-step analysis of the use case, information exchanged, requirements, common terms and definitions and custom information.

The **General Information** is where the high-level description of the use case is presented, the scope, objectives and goals specified and KPIs set. The Function part has the UML diagrams and a plaintext narrative field for describing the use case. After that, the Technical Details focus on actors, step-by-step analysis of the use case and different scenarios and the information exchanged and respective flows with presentation of process sequences, data types and requirements. The Additional Information gives supplementary details about terms and definitions important for the use case comprehension [2].

The **Part III** defines the serialization into XML syntactic format of a use case template and all the requirements associated. The XML format is crucial in the definition and standardization of importing and exporting processes of the use case information between different software's and repositories. It also establishes the interface between the XML data and the graphical UML use case diagrams [1].

All the parts from the standard and their relationship are presented in the scheme above (Figure 1). **R&D Nester** have already produced some business and system use cases applying the IEC 62559 standard in **TDX-ASSIST**, **ONENET**, **GIFT**, among others projects. Some of these use cases can be accessed in the public smart grid use cases repository [3], which is an easily accessible use-case repository for users with different background, based on the use-case methodology defined in the **standard IEC 62559-2:2015**.

References:

[1] https://syc-se.iec.ch/deliveries/iec-62559-use-cases/

[2] Gottschalk M., Uslar M., Delfs C. (2017) Use Cases - The IEC 62559 Methodology. In: The Use Case and Smart Grid

Architecture Model Approach. SpringerBriefs in Energy. Springer, Cham. https://doi.org/10.1007/978-3-319-49229-2_2

[3] https://smart-grid-use-cases.github.io/

LITERATURE REVIEW

Future Energy Scenarios 2021 - National Grid ISO

What are the **Future Energy Scenarios** and why are they important?

With an ambitious target for **net zero emissions by 2050**, our energy system will need to transform rapidly while continuing to deliver reliability and value for consumers.

This publication explains the concept that decarbonising energy is possible but also that it will be complex, not least because there are many ways to reach net zero, each with their own trade-offs.

"Future Energy Scenarios (FES)" outline four different, credible pathways for the **future of energy between now and 2050.**

Each one considers how much energy we might need and where it could come from. The overall scenarios remain consistent with those in **FES 2020** but the details within them are new for 2021 following extensive modelling, research and stakeholder engagement.

FES can be used to inform a range of energy system activities including network operation, investment decisions and energy policy.



Link for publication

Final Report on the Power System separation of Iberia from Continental Europe on 24 July 2021

On Saturday, 24 July 2021 at 16:36 CET, the **Continental Europe (CE) Synchronous Area** was separated into two areas due to cascaded trips of several transmission network elements. Specifically, the Iberian Peninsula, comprising the systems operated by REE and REN, was separated from the rest of CE. Immediately after the incident occurred, European Transmission System Operators (TSOs) began to resolve the situation, resynchronising the Continental European power system at 17:09 CET.

In the immediate aftermath of the system separation, European TSOs, in close collaboration with ENTSO-E, decided to start a joint process to collect all relevant facts regarding the incident. This process was launched through the coordination of an ENTSO-E Task Force with the clear mission to deliver these facts to national and European authorities and **ENTSO-E** members, as well as to any interested party, in a transparent and complete manner.

The **Task Force**, composed of the European TSOs, has been coordinating all relevant ENTSO-E bodies in analysing the event and is responsible for the development of the Technical Report and for overseeing the communication of facts to external stakeholders.

This **Final Report** presents the results of the investigation carried out by the Task Force. The investigation has classified the event according to the Incident Classification Scale (ICS)[1] Methodology

as a Scale 2 event, being the most critical met criterion L2 - Incidents on Loads (see Section 12) and, therefore, a relevant investigation Expert Panel was set up, starting its work on 22 October 2021. The Task Force assisted with the development of the work within this Expert Panel and delivered a factual report on 12 November 2021 and the present final report published on 25 March 2022.

[1] ENTSOE-E Incident Classification Scale (ICS) methodology of 4 December 2019



Link for publication

World Energy Issues Monitor 2022

The **World Energy Issues Monitor** provides a snapshot of what keeps CEOs, Ministers and experts awake at night in nearly 100 countries. The Monitor helps to define the world energy agenda and its evolution over time. It provides a high-level perception of what constitute issues of critical uncertainty, in contrast to those that require immediate action or act as developing signals for the future. It is an essential tool for understanding the complex and uncertain environment in which energy leaders must operate, and a tool through which one can challenge one's own assumptions on the key drivers within the energy landscape.

This year's World Energy Issues Monitor reflects enormous uncertainty about the best way to manage climate change as we recover from the **COVID-19 crisis**, in an environment of rising energy costs. Undertaken in the weeks immediately following the **COP 26 Conference** in Glasgow in late 2021, this survey also highlights shared concerns about the rise of national interests in the face of climate change - a red signal for humanity.

Energy matters are centre stage in a world of more digitally connected, politically contested, interdependent, and diverse energy societies. Leadership agendas are focussed on the complex coordination challenges of managing faster-paced global energy transitions, without triggering new threats to regional and global peace.

In parts of the world many of the issues addressed in this publication have manifested themselves in the form of public uproar, notably around energy prices, costs and affordability as well as climate management.

Better solutions in energy for people and planet are possible, but not simple. They require new models of human and economic development and a shift from incremental improvements to transformation

strategies that work across borders, across sectors, involve all levels of society, and deal with more than one issue at a time.



Link for Publication

EVENTS

2 -3 Jun 2022
OPORTO, PORTUGAL
CIRED PORTO WORKSHOP 2022 - E-MOBILITY AND POWER DISTRIBUTION SYSTEMS

6 -8 Jun 2022
ONLINE
WEATHER FORECASTING FOR POWER AND UTILITIES 2022

14 -14 Jun 2022
ONLINE
INNOGRID 2022 PROJECT SESSION

27 -1 Jun /Jul 2022
OPORTO, PORTUGAL
XXII POWER SYSTEMS COMPUTATION CONFERENCE

28 -2 Aug /Sep 2022
PARIS, FRANCE
CIGRÉ SESSION 2022

10 -14 Oct 2022
DELFT, THE HAGUE, NETHERLANDS
RENEWABLE ENERGY GRID INTEGRATION WEEK

24 -27 Oct 2022
SAINT PETERSBURG, RUSSIA
25TH WORLD ENERGY CONGRESS 2022

12 -15 Jun 2023
ROME, ITALY
CIRED 2023 INTERNATIONAL CONFERENCE &

QUIZ

1) DURING JANUARY AND FEBRUARY 2022, WHAT WAS THE TOTAL ENERGY CONSUMPTION FROM NATURAL GAS IN PORTUGAL:

- a) 2.5 GWh
- b) 6.0 GWh
- c) 10.6 GWh
- d) 14.8 GWh

2) WHAT WERE THE MAIN SOURCES OF NATURAL GAS IMPORTATIONS IN PORTUGAL, DURING 2022, AND THE CORRESPONDING PERCENTAGES?

- a) 100 % from LNG Terminal in Sines
- b) 75 % from LNG in Sines and 25 % from Interconnections with Spain
- c) 50 % from LNG in Sines and 50 % from Interconnections with Spain
- d) 100 % from Interconnections with Spain

3) IN 2021, THE PORTUGUESE GOVERNMENT ANNOUNCED THE SHUTDOWN OF THE LARGEST PORTUGUESE POWER PLANT IN SINES, FUELED BY COAL. WHAT IS THE REMAINING COAL FIRED INSTALLED CAPACITY IN PORTUGAL?

- a) 0 MW
- b) 618 MW
- c) 1256 MW
- d) 2052 MW

4) DURING THE FIRST TWO MONTHS OF 2022, PORTUGAL IS FACING SEVERE DRY CONDITIONS, WHICH FORCED THE SHUTDOWN OF DIFFERENT HYDROELECTRIC PLANTS. DURING THIS PERIOD, WHAT WAS THE MAIN SOURCE OF ELECTRICITY IN PORTUGAL?

- a) Wind
- b) Sun
- c) Natural Gas
- d) Imports from Spain

5) SOLAR PHOTOVOLTAIC (PV) ENERGY IS CONSIDERED AS ONE OF THE MOST IMPORTANT CONTRIBUTORS TO THE ONGOING ENERGY TRANSITION. RECENTLY, PORTUGAL OVERCOME WHICH SYMBOLIC VALUE FOR TOTAL PV INSTALLED CAPACITY?

- a) 10 MW
- b) 100 MW
- c) 1 GW
- d) 10 GW

6) DUE TO THE EXISTING NATIONAL AND INTERNATIONAL CONTEXT, THE MARKET PRICES FOR ELECTRIC ENERGY IN MIBEL (IBERIAN MARKET) HAVE BEEN INCREASING SUBSTANTIALLY. AS REFERENCE, THE AVERAGE PRICE FOR ENERGY IN 2019 WAS 55.22 €/MWH. WHAT WAS THE AVERAGE PRICE FOR ENERGY IN FEBRUARY 2022?

- a) 60.5 €/MWh
- b) 92.64 €/MWh
- c) 153.87 €/MWh
- d) 200.72 €/MWh

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) 10.6 GWh
2. Answer: a) 100 % from LNG Terminal in Sines
3. Answer: a) 0 MW
4. Answer: c) Natural Gas
5. Answer: c) 1 GW
6. Answer: d) 200.72 €/MWh

LINKS

ON RESEARCH, DEVELOPMENT AND INNOVATION

Portugal

- Portugal 2020
- Portal da Inovação
- Agência Nacional de Inovação
- COTEC Portugal
- Portugal in Europe Research and Innovation Network (PERIN)
- Agência para o Desenvolvimento e Coesão (AdC)
- Direção-Geral de Estatísticas da Educação e Ciência (DGEEC)

OTHER ENTITIES

Portugal

- Laboratório Nacional de Energia e Geologia (LNEG)
- Associação de Energias Renováveis (APREN)
- Associação Portuguesa da Economia da Energia (APE)
- Portugal Energia
- Portal de Ciência e Tecnologia | Fundação para a Ciência e a Tecnologia (FCT)
- ERSE - Entidade Reguladora dos Serviços Energéticos

- DGGE - Direção-Geral de Energia e Geologia

Europe

- BRIDGE (H2020)
- European Energy Research Alliance (EERA)
- ETIP SNET - European Technology and Innovation Platform Smart Networks for Energy Transition
- Horizon 2020
- Horizon Europe
- BlueInvest
- EIT InnoEnergy
- Eurostat - Science, Technology and Innovation
- Funding, Tenders | European Commission
- Research and Innovation | European Commission
- Energy, Climate Change, Environment | European Commission

Rest of World

- China Electric Power Research Institute (CEPRI)
- Mission Innovation
- Innovation – Department of Energy (USA)
- NREL – National Renewable Energy Laboratory
- EPRI- Electric Power Research Institute
- EU-GCC Clean Energy Technology Network

Europe

- European Network of Transmission System Operators for Electricity (ENTSO-E)
- The European Wind Energy Association (EWEA)
- The Alliance for the Internet of Things Innovation (AIOTI)
- JRC Publications - Joint Research Centre - Smart Electricity and Interoperability
- The European Commission's Priorities
- A European Green Deal | European Commission
- A Europe fit for the digital age | European Commission
- European Climate, Infrastructure and Environment Executive Agency (CINEA | ex-INEA)
- EUASP - The European Union Agency for the Space Programme
- ESA - The European Space Agency

Rest of World

- CIGRE - International Council on Large Electric Systems
- CTCN - Climate Technology Centre and Network
- GEIDCO - Global Energy Interconnection Development and Cooperation Organization
- Energy Web
- World Intellectual Property Organization (WIPO)
- International Energy Agency (IEA)
- International Electrotechnical Commission (IEC)

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