

Recent activities

Workshop towards regulators, Ljubljana, 30th of June

UMBRELLA, ITESLA and GARPUR projects have organised a workshop together with ACER (Agency for the Cooperation of Energy Regulators). The aim of this workshop was to raise awareness about potential impacts for regulators of these

projects and to inform them about the research activities. From the regulator's feedback it became clear that the regulators were interested and would like to be further informed.

PSCC Conference, Wroclaw, Poland, 18th - 22nd of August

The UMBRELLA consortium presented three papers on risk-based security assessment, which were met with interest from the audience. The paper "Risk-constrained optimal power flow with probabilistic guarantees" was selected for additional journal publication in the special edition of IJEPES



Presentation at PSCC

CIGRÉ Paris Conference, 29th of August

In the previous newsletter we announced the UMBRELLA project's participation to CIGRÉ Paris 2014. We contributed five posters to poster session, where Mr. Supponen from the European Commission kindly paid us a visit during the day.



Visit of Mr. Supponen

UMBRELLA Workshop on System State Modelling and Toolbox Design, 23rd of October

Twenty-five participants were present for the UMBRELLA project's open Workshop on System State Modelling and Toolbox Design at the ENTSO-E premises, Brussels. All interested parties were able to see the latest work of all work packages in detail and were able to ask questions. The presentations can be downloaded from the website: e-umbrella.eu/documents.



Umbrella Workshop

In this newsletter

- › Recent activities
- › Main work package [WP] achievements
- › Recent publications

Upcoming Events

- › InnoGrid2020+
31st of March - 1st of April 2015
- › IEEE PowerTech
29th of June - 2nd of July 2015



UMBRELLA project main objectives

- › Develop an innovative toolbox to support the decentralised grid security approach of TSOs.
- › Demonstrate the enhancement of existing and running procedures by utilisation of the developed toolbox.
- › Provide a scientifically sound basis to support common TSO decisions.

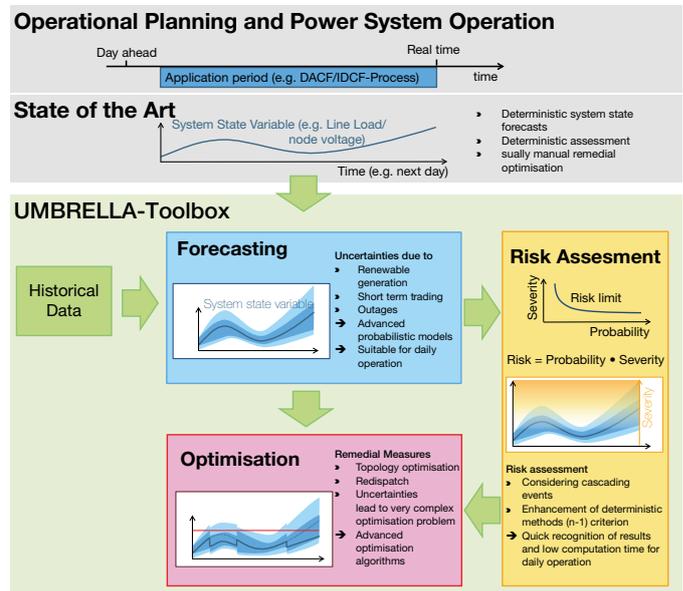
Work packages

General UMBRELLA overview

UMBRELLA is developing an innovative toolbox to support the decentralised grid security approach of TSOs, giving the opportunity to increase cooperation when facing the increased complexity in system's operation. A decentralised network security analysis with everyone "on board" looking at the same results and evaluating solutions in a coordinated and optimised way, increases the efficiency of the network operation. Furthermore, UMBRELLA methodologies gives a step forward in the evaluation of uncertainties and their impact in different operational time-frames, the introduction of risk-based assessment and optimisation of remedial actions. This toolbox to be used in different operational time-frames includes:

- ▶ Modelling and simulation of uncertainties due to market activities, renewable energy sources on different time scales (RES forecast) and outages [WP2]
- ▶ Optimisation algorithms of remedial actions in reaction to simulated risks on different time scales according to total costs and transmission capacities [WP3]
- ▶ Development of risk based assessment concepts for anticipated system states with and without corrective actions [WP4]

To perform the presented work, UMBRELLA has the following project structure:



All this will be integrated into one toolbox [WP5]. Finally, the functionality of this toolbox will be tested and demonstrated [WP6].

Recent UMBRELLA publications

All publications can be found on our website:
www.e-umbrella.eu/documents

- ▶ "Impact of correlated infeeds on risk-based power system security assessment", M. d. Jong, G. Papaefthymiou, D. Lahaye, C. Vuijk and L. v. d. Sluis, PSCC, Wroclaw, Poland, 2014
- ▶ "Probabilistic Cascading Event Risk Management", K. Köck, H. Renner, J. Stadler, PSCC, Wroclaw, Poland, 2014
- ▶ "Risk-Constrained Optimal Power Flow with Probabilistic Guarantees", L. Roald, M. Vrakopoulou, F. Oldewurtel and G. Andersson, PSCC, Wroclaw, Poland, 2014

Work package 2: Final Evaluation of System State Forecasting Methods

WP2 is concerned with the assessment and description of uncertainties that influence the grid operation notably. Thereby, the uncertainties are described in a way that allows for a straightforward integration of the additional information into the TSO's operational planning. Therefore, so-called system state parameters, which characterise crucial information about the whole system in a feasible way for operational processes, have to be derived and subsequently forecasted.

The forecast uncertainties of renewable energy in-feed and load are modelled at each grid node with non-parametric kernel density approaches. The spatial interdependence of each factor is described with a copula. The uncertainty of short-term trading is modelled by a merit order model, which takes the

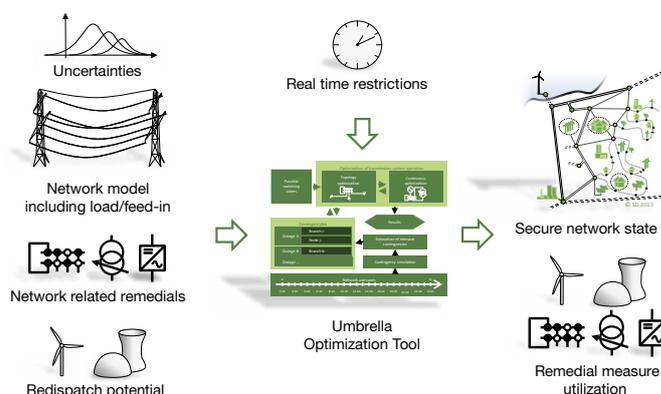
forementioned uncertainties as input. This allows for running a Monte-Carlo simulation that returns the distributions of load and in-feed at each grid node. With subsequent load-flow calculations, the distributions of system state parameters (line loading, voltage etc.) can be computed. By filtering critical systems states and their respective forecast conditions, the relationship can be used to forecast critical system states.

The methods for describing the uncertainties have been fully developed and tested. Currently, the developed methods for forecasting critical system states are tested. The results will soon be made available in the deliverable D2.2 "Report on methods for system state forecasting".

Work Package 3: Development of Optimization Algorithms Considering Uncertainties

The aim of the UMBRELLA Project is to assist transmission grid operators to ensure secure transmission grid operation. Therefore, optimization algorithms have been developed, which are capable of determining remedial measures to maintain system security at minimal costs. In order to provide system operators with adequate action recommendations, it is of special significance, that these algorithms take into account all available remedial measures as well as all relevant contingencies. In particular, relatively new technologies with great influence on power flows like HVDC connections operated in parallel to the asynchronous grid and phase shifting transformers are considered among conventional measures like topology modifications and redispatch. The new options in transmission grid operation resulting from an increased controllability of load flow control devices in contingency situations are optimized as corrective remedial measures and provide significantly increased flexibility to transmission system operators in stressed grid situations. However, uncertainties resulting from error-prone feed-ins of renewable energy sources can lead to deviations from anticipated system states. A reasonable way to deal with this issue is to postpone activation decisions of remedial actions as long as possible and react if critical deviations from anticipated

system states actually occur. Therefore, a short term optimization algorithm has been developed, which takes into account measures available on a very short term as well as real-time constraints. Nevertheless, it is crucial for system security to avoid unmanageable system situations. To deal with this issue, probabilistic optimization algorithms have been developed, which are capable of directly incorporating uncertainties within the operational planning process. This way, especially optimal power plant start-up decisions, which have to be performed up to 24h before the actual operation, can be taken.



Work Package 4: Controlling risk with FACTS, HVDC and market design

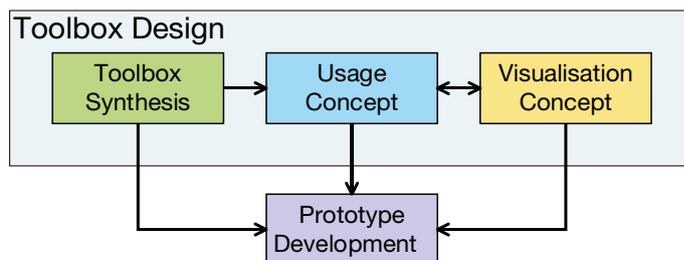
WP4 encompasses both the probability and the severity of events. Since the beginning of the UMBRELLA project, we have developed and tested different models for power system operational risk and different representations of uncertainty related to fluctuating in-feeds from RES. The result is a set of methods which can be used for a risk-based security assessment, including both risk-based, probabilistic optimal power flow (OPF) formulations and methods for probabilistic evaluation of the risk from cascading events.

The last deliverable of WP4 is “D4.3 Methods for optimization

of power transits” and has two parts. First, the previously developed risk-based methods have been extended to handle state-of-the-art technological means such as HVDC and PSTs. This allows for an assessment how HVDC and PSTs can be used to reduce risk and handle uncertainty, thus allowing for an optimization of the power transfer capacities. Second, the developed methods are used to assess how different market designs and cooperation rules influence the risk in system operation. The deliverable will be available on the homepage from beginning of 2015.

Work Package 5: Development of the Usage and Visualization Concepts

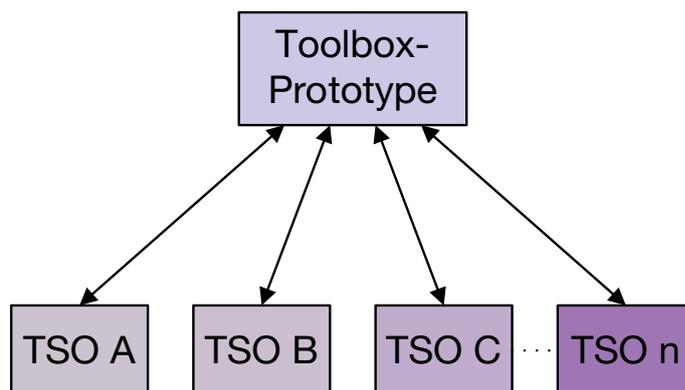
The review of the concepts developed for forecasting, optimization and risk-based security assessment is completed and led to the selection of those functionalities and modules which will be included in the toolbox design and the development of the toolbox prototype. The synthesis of the selected modules with the expectations and requirements formulated by TSOs is finished as well.



The conclusion of this work forms the basis for the developing of a toolbox design and of the toolbox prototype which will be used for demonstration purposes and tested by TSOs.

First steps on the development of the usage and visualization concepts have been carried out. The work on both concepts started with an analysis of the scientific state-of-the-art and the approaches currently applied by TSOs. Based on the results of the analysis, the two concepts will be developed as part of the toolbox design and integrated in the prototype. The feedback provided from the testing of the prototype will show if these concepts fulfil the requirements by TSOs in terms of the integration of the toolbox in the existing processes and of the plain interpretation of the results obtained by operating the toolbox.

The discussion on the setup of the toolbox prototype concluded in a centralized approach, i.e. the toolbox prototype will be installed on a central server.

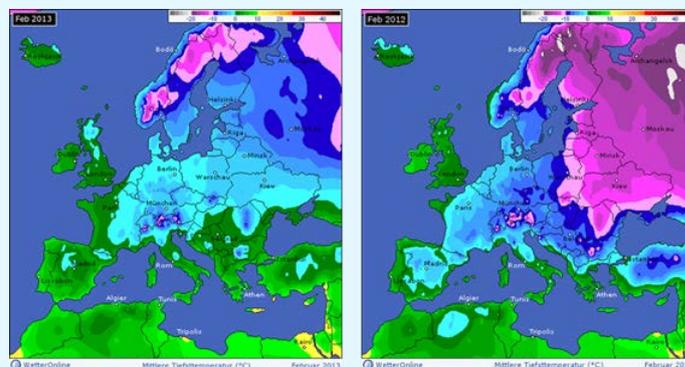


The TSOs executing the demonstration and testing will have access to the central server and be able to run the toolbox prototype. The major advantages of such an approach is the fact that a bidirectional communication is required between the central server and the users/testers of the toolbox prototype only and no data exchange between the different TSOs is required. Furthermore the implementation of experimental software in secured TSO-IT-systems is minimized. Nevertheless a decentralized use of the toolbox is possible by using an appropriate IT-framework.

Work Package 6: Finalizing the “Test-Book” and First Testing Workshop

Since the last newsletter two major steps have been taken forward within the demonstration and testing part of the project. Step one was the finalization of the “test-book”. Three test cases have been chosen which are each described with a general synopsis by all TSO. Furthermore, every case features detailed descriptions by each TSO concerned, comprising the encountered grid situation, the countermeasures taken and the expectation of the TSO regarding the toolbox results. The test case “Cold snap February 2012” has also been harmonized with the FP7-project iTESLA. The other test cases cover more aspects - e.g. high wind in-feed in the northern part of Germany and different seasonal current limits on lines.

Step two was the first testing workshop. Due to the mixed approach of a physical meeting with the possibility to participate via web conference, all involved TSOs could participate in the test. Although, in this stage of the prototype only the deterministic functions of the toolbox are available, the optimization possibilities and the short computation time were really impressive. Further guided online test sessions and two physical



Average minimum temperatures in February 2012 & 2013 to illustrate the cold snap period graphically. (source: www.wetteronline.de)

meetings shall be held to roll out the additional functions of the toolbox. Within these sessions, users will get more acquainted with the toolbox and feedback for the improvement of the toolbox prototype will be collected.



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