SERVICE DE METROLOGIE NUCLEAIRE
RELIABILITY AND SAFETY OF POWER SYSTEMS

MASTER THESES

Academic year **2020-2021**

*The topics listed below correspond more to **themes** in which master theses can be realized, than to a detailed description of topics. Depending on the interest of the students, more theoretical or instead industry-related topics will be developed. Some of the proposed themes are more convenient for an **internship**, to be made before the master thesis.*
*The themes proposed are preferably **accessible mainly to students in engineering physics and in electromechanical engineering**.*

Robustness of electrical grid reliability indicators

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Context & objectives
Elia is the operator of the Belgian high-voltage grid from 380 kV to 30 kV. Elia is responsible for the development and maintenance of this network, opens it to users and regulates energy flows. As owner and operator of electricity transmission networks in Belgium and Germany, Elia has an important role and mission in supporting and implementing Europe's energy and climate policy.

In this context, Elia must manage its resource in an optimal way to be able to develop its grid to host and transport the increasing amount of renewable energy while maintaining a high security of supply of all its customers. It is therefore important to identify which assets contribute the most to the grid reliability and which actions (maintenance or replacement) are the most efficient to decrease the system risks in terms of Energy Not Supplied , Energy Not Injected and potential redispatching costs.

A method is under development to compute system risk and risk reduction potential of specific actions based on incident simulation results (contingency load-flow) and asset failure rates and unavailability data.

Those indicators are and will remain subject to many uncertainties linked on one hand to the evolution of the system needs such as

- Electrical load: new clients, penetration of electrical vehicles, impact of energy efficiency measures
- Power generation: wind, solar, CHP
- Development of energy storage

And on the other hand to the difficulty to assess asset failure rate and down times that could evolve with maintenance practices and technological development.

The goal of this thesis is to evaluate sensitivity of the proposed risk indicators to uncertainty of the used hypothesis in order to evaluate robustness of typical grid structure and grid investments (new high-voltage interconnections, substations and/or transformers) proposed for the future.

The student will be able to develop knowledge and competences regarding the grid development and asset management of the electrical network but also in the fields of system reliability and data handling which are useful in many industries.

Work description

- Familiarize yourself with the proposed method for risk computation, available data and already available R scripts
- Propose different sensitivity indicators based on total system risk, risks linked to a particular asset or a particular client.
- Compute those on a practical case based on Elia grid. This will be done preferably in the programming language R.
- Propose ways to visualize those indicators in order to facilitate the analyses and decisions