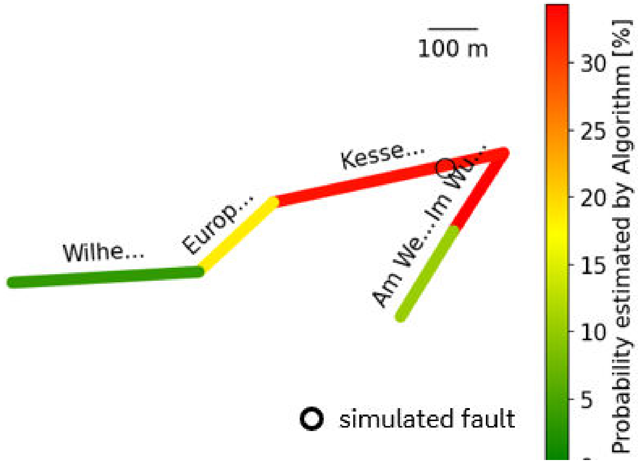
SUCCESS CASE 39.2025

Self-Healing Systems

USING AI TO REDUCE ENERGY LOSSES DURING OUTAGE



THE CHALLENGE

The main challenges addressed by the Self-Healing Systems project included:

- Unlocking **automated self-healing procedures to handle faults and outages** in the distribution grid.
- Dealing with sparse and heterogeneous measurement infrastructure and optimally **exploiting available data for improved decision-making**.
- Defining **requirements and priorities** for the instrumentation, digitalization and automation of the distribution grid.

THE SOLUTION

To overcome the described challenges, the DSO Avacon of the E.ON Group developed with the Fraunhofer IEE Institute a software consisting of these main innovative features:

- Modular deployment of independent modules for state estimation, state forecasting, fault location, fault isolation and grid reconfiguration, which all contribute to the overall goal of **fault management and optimal grid reconfiguration**.
- Use of innovative approaches based on artificial intelligence (AI) to enable the processes of **state estimation, state forecasting and fault location**, including cases with a limited number of measurement devices in the field.
- Definition of innovative approaches for **fault isolation and grid reconfiguration** that can be used with **different levels of automation** (from a simple recommendation system for human operators to a fully automated process) and that take into account the implications of hybrid scenarios with both remotely and manually controllable assets (e.g., switches).

MAIN ACHIEVEMENTS

The concrete achievements reached so far include:

- Validation of the developed AI-based modules using **real grid and measurement data** and proof of the accuracy performance, including in the case of unobservable grids (i.e., grid areas over which the system operator has no visibility).
- Demonstration of the **modular deployment and the coordinated operation** of the developed methods in a real-time environment.
- Proof of the achievable benefits using the developed tools in support of grid operation, planning and general decision-making in complex and uncertain scenarios.

KEY SUCCESS FACTORS

The requirements and enablers necessary for the successful roll-out of the solution are:

- **Digitalization of the grid data** as well as **real-time availability of**, at least, some **measurement information** from classical meters and fault recorders.
- **Microservice-based software infrastructure** for the modular deployment of modules for state estimation, state forecasting, fault location, fault isolation and grid reconfiguration, as well as defined **interfaces for input and output data communication** among the software modules.
- AI-based modules with defined processes for **continuous training, integration of new data and adaptation** to possible changes in the grid.

WAY FORWARD

The next planned steps for the demonstration of the solution in an operational environment are:

- Deployment of the microservice-based software infrastructure in a production environment and **integration** of the needed services.
- Adaptation of the required interfaces for **interconnection with the real-time system for the collection and processing of real-time data**.
- Long-term running of the services and the infrastructure within the operational system for **further verification and validation**.
- Deployment and **testing of the services with other electrical grids** for further verification and validation of the generalizability of the developed approaches.

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