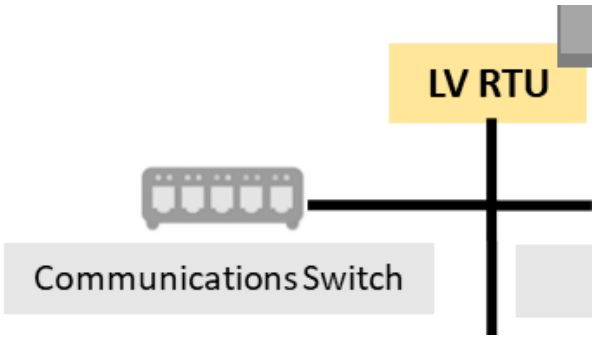
SUCCESS CASE 15.2024

LV Automation

LV AUTOMATION FOR RESILIENT, FLEXIBLE AND OPTIMIZED SMART DISTRIBUTION GRIDS



THE CHALLENGE

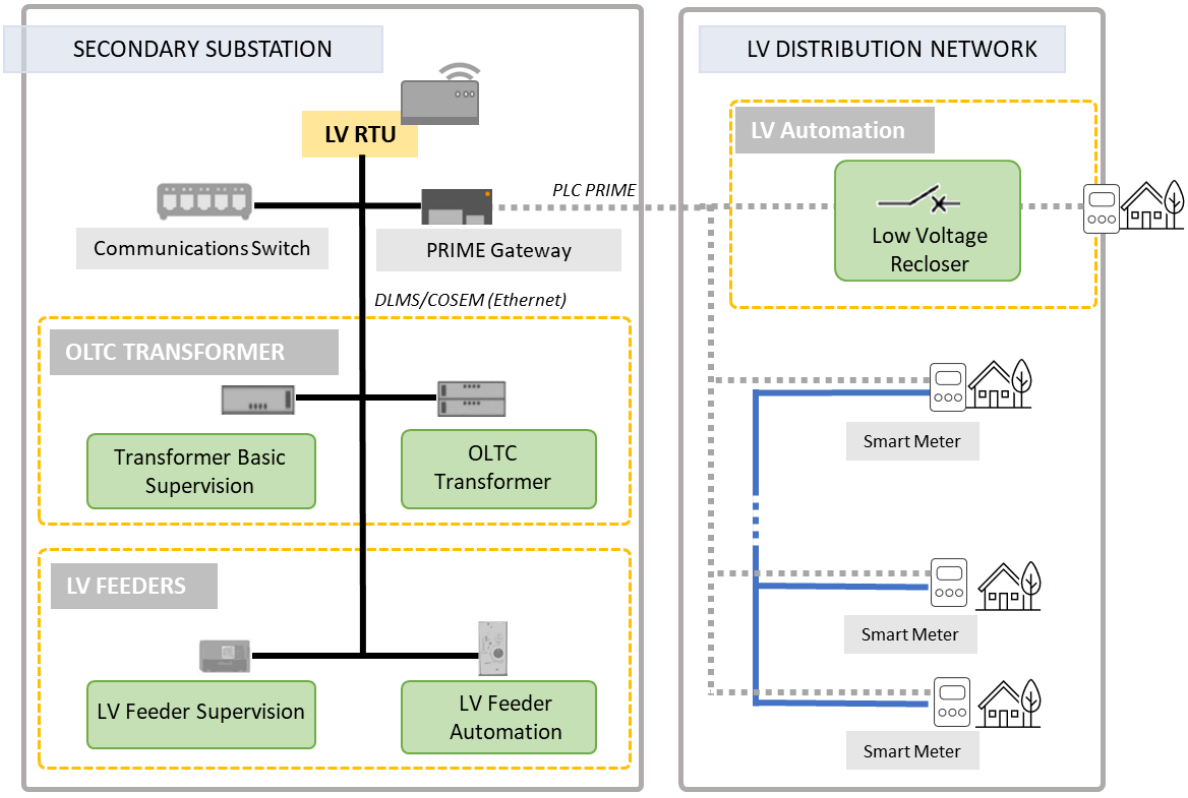
One of the main challenges currently faced by DSOs is the expected increase in electric vehicle (EV) charging sessions, which could affect the **quality and quantity of the electricity supply** (e.g., due to interruptions, voltage variations, etc.). Moreover, the consequences of Russia's invasion of Ukraine and climate change are impacting the European strategy and discussions around the evolution of our energy system. Distributed energy resources (DER) are one of the keys to reaching energy independence and obtaining benefits from the use of their reactive power capabilities (voltage regulation).

In this uncertain and evolving scenario, DSOs play a fundamental role in providing a secure and high-quality electricity service. Thus, first of all, monitoring the real-time operating conditions of low voltage (LV) networks becomes essential for the efficient operation of the power system. Advanced monitoring solutions (e.g., measurements per each LV panel and feeder) have been deployed in the LV networks since last decade, proving the need for deploying LV automation solutions. As a next step, this would allow new decision-making approaches and interactions with the network based on all the obtained information (in terms of power flow, phase unbalance, voltage level and other power quality indicators) through **LV automation solutions**. This real time interaction with the grid has the objective of creating a **resilient, active, flexible and optimized LV distribution network**.

THE SOLUTION

All monitoring and automation solutions deployed by i-DE are coordinated through a LV remote terminal unit (LV RTU), where obtained data is exploited and operated through a Supervisory Control and Data Acquisition (SCADA) system, using standard real-time protocols (e.g., IEC 60870-5-104, DNP3, etc.). From the perspective of cybersecurity, the adoption of LV automation solutions incurs critical potential vulnerabilities (e.g., disruptive injection of false data, remote supply disconnection, etc.). In many markets, the need for secure LV automation protection and

control systems is being encouraged by regulations to ensure the security of supply. Hence, the standard IEC 62443-4-1, named *Security for industrial automation and control systems*, is used as reference to define the cybersecurity requirements. This defines a secure product development process, comprising eight *practices* that address developing, maintaining and retiring hardware, software or firmware.



LV Automation functionalities deployed in the secondary substation.

The proposed solution consists in replacing typical LV switchgears with a subset that contains an electronically-controlled circuit breaker and a backup fuse in series (per phase and feeder). The main technical challenge of this protection device is to make it compatible with existing secondary substations through a product design with reduced dimensions that can be mechanically compatible with a standard LV switch.

The solution is used to perform **control strategies** (using switching capabilities), as well as to **maintain protection capabilities** (where selectivity is a key challenge). Additionally, it can be used as a recloser in case of intermittent faults in the LV network. Automatic **circuit reclosers** are recognized by electric utilities throughout the world as an essential device for ensuring availability of electricity supply to their customers. An automatic circuit recloser (installed per

phase and feeder) is a self-contained device with the necessary intelligence to sense overcurrent and time and to re-energize the line by reclosing automatically (following ANSI Code 79). If a fault is permanent, the recloser locks open after a preset number of operations, isolating the faulted section from the main part of the system.

MAIN ACHIEVEMENTS AND WAY FORWARD

In order to maintain security and quality of supply while supporting increased intermittent distributed generation and electrification of transport at the LV network, the provision of flexibility and resiliency in distribution network operation is critical. The proposed LV automation solution has the potential to become an active part of the design of such a resilient, flexible and optimised LV distribution network, which will:

- **Minimize bottlenecks and congestion points**.
- **Minimize/postpone network upgrade investments**.
- **Ensure power quality and security**.
- Enable an **optimized management** of upcoming **flexibility** scenarios.

Additionally, as electrical systems are becoming more and more complex, protection systems are also becoming more complex. At the same time, the consequences of protection failures are becoming costlier and more disruptive. Therefore, there is a need to define the functionality of protection devices and their protection functions at the basis of these systems. To meet this need, the proposed solution considered several IEC 60255-1xx series of functional standards dedicated to protection relays and protection functions as reference.

The next planned steps for this initiative are to build the business case according to the investments needed and the obtained savings in order to extend the functionality in the LV network and scaling the system.