EU-SysFlex

Italian Demo:

Flexibility services provision from resources connected to the MV DSO

The Italian Demonstrator explored the evolution of distribution network infrastructure, by integrating monitoring systems with advanced smart grid devices, in order to drive toward a new grid approach, in terms of operation and infrastructure, supporting ancillary services provision to the transmission network, taking into account both TSO and DSO needs and constraints, and introducing the flexibility services.

This is possible due to:

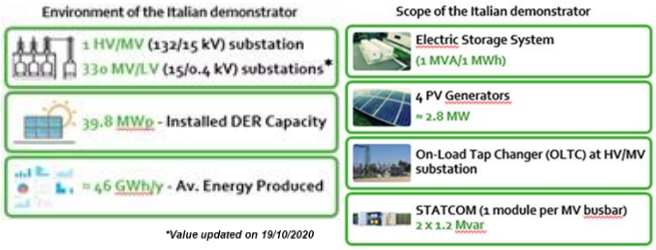
- Tools, systems and devices development and integration within the DSO infrastructure;
- Implementation of developments aimed at improving coordination between the TSO and DSO;
- Improvement of distribution network observability and forecasting systems;
- Optimisation of distribution network operation by exploiting DERs and DSO assets.

Key Features

The Italian Demo introduces the following innovative elements:

- Exploitation of STATCOMs, for voltage support, reactive power regulation and power factor correction;
- Aggregated reactive power capability calculation, which allows the DSO to share with the TSO the amount of reactive power that can be provided by local resources;
- Improved network calculation platform for computing active and reactive power set-points at the Primary Substation;
- Improvement of data exchange between DSO and TSO for better observability of aggregated decentralised resources at the primary substation interface.
- Congestion management and frequency balancing services, which involve RES and Storage, have been simulated; for voltage regulation features, all the available resources are included within the experimentation.
- New automated coordination process between DSO and TSO, realised using an IEC 104 protocol simulator, which acts as a substitute in the transmission of some specific signals and measurements between the DSO and TSO.

Implementation approach

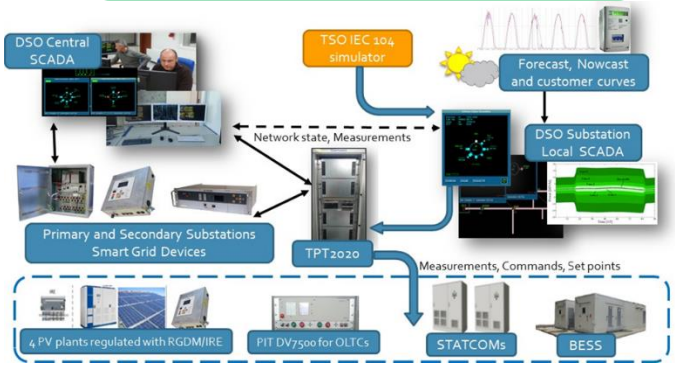


The Italian Demonstrator includes and exploits the integration of SCADA systems and a set of Smart Grid devices, called to perform remote control and monitoring of the distribution network, fault detection and regulation issues on RES and DSO assets.

SCADA Systems

The **Central SCADA** is the monitoring and remote control system of the regional distribution network. It includes a database of the electrical network, and sends commands to devices in the Primary Substations and to remotely controlled Secondary Substations. The **Local SCADA**, located in Quarto Primary Substation, is synchronized with the Central SCADA; it collects field measurements, routes the local set-points to be implemented by TPT2020 at each resource or DSO asset, and runs the **NCAS** (Network Calculation Algorithm Systems) which performs State Estimation and Network Optimization calculations.

Regarding TSO coordination aspects, the SCADA systems are interfaced with a **TSO protocol simulator**.



Smart grid devices

The HV/MV substation **RTU** (**TPT2020**) implements standard remote-control features and manages advanced voltage regulation functions. It sends commands and setpoints to the following Primary and Secondary Substation IEDs:

- **DV7500** – Integrated Transformer Protection. It performs automatic voltage regulation, acting on the OLTCs of HV/MV Transformers;
- **DV7203** – HV/MV Substation feeder protection panel, with advanced network automation features;
- **RGDM** – MV/LV Substation advanced fault detector, able to guarantee advanced network automation features, it can communicate with **IRE** (Energy Regulation Interface) to establish set-points on full controllable PV plants.

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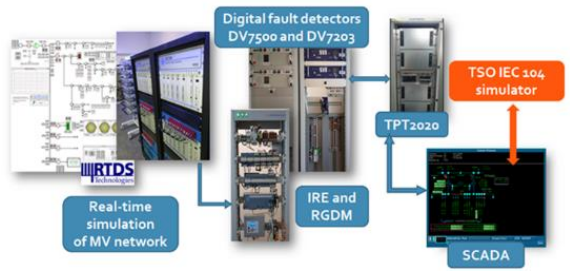
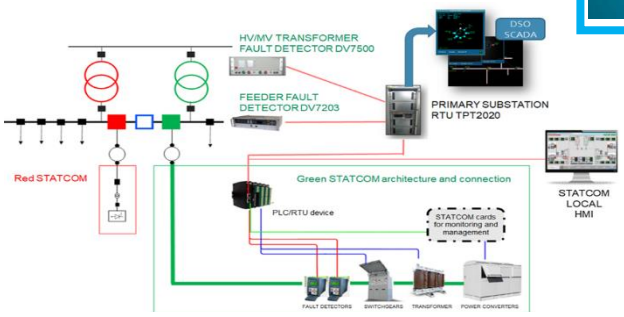


Integration tests

Integration tests were performed within the Smart Grid "Grid-in-the-loop" Test System of E Distribuzione in Milan by using a Real-Time Digital Simulator (RTDS). The simulated digital and analogue quantities were imported/exported from, and to, real IEDs. Results show that the SCADA acquires all measurements and signals from the configured smart grid devices and sends all commands, such as Q set points, to the simulated PV plant and V set points to the DV7500.



The STATCOM

A STATCOM is an electrical device capable of injecting modulated reactive power to the network to which it is connected. From a network operation perspective, STATCOMs are comparable to rotating synchronous compensators. Not being a rotating device, it is not affected by mechanical inertia, and so it can provide a faster response for power factor correction and voltage stabilisation.

Key Achievements

Results from the Italian demo prove that E-distribuzione can implement an efficient solution to:

- provide an aggregated information of network capability at its Provide aggregated information of network capability at its interface with the TSO;
- Provide the TSO with better observability of DERs, making use of forecasting tools for enhanced network state estimation and computation of reactive power capability;
- Improved data exchange between the two System Operators, to guarantee safe operation of the electrical system;
- Demonstrate STATCOM usefulness, in terms of reactive power management.

STATCOM operation on the distribution network enables the following benefits:

- Limiting reactive power flows at the Primary Substation;
- Meeting TSO requests at TSO/DSO interface;
- Supporting voltage control;
- Power factor compensation.

Findings

The first important benefit derived from the developments made within the demonstrator involve improved observability of resources connected to the distribution network.

The advanced forecast, combined with network state estimation and a function to calculate reactive power capability, demonstrate that the DSO can provide the TSO with reliable information on the amount of power, in particular reactive, that can be provided by local resources.

Besides, improved observability of distributed resources, the approach also supports network state estimation, contributing to better network management.

Results from offline and real-time tests demonstrate the capability of the DSO to support TSO requests. Considering also that the STATCOM is a new device for the E-distribuzione infrastructure, the project tests represented the opportunity to demonstrate its successful operation, in terms of reactive power capability management, and providing the following benefits: limiting reactive power flows at the Primary Substation; meeting TSO requests at TSO/DSO interface; supporting Voltage Control; power factor compensation.

Recommendations and Lessons

Efficient and effective TSO-DSO coordination process should be based on the following principles:

- DSOs need to adopt smart grid solutions to improve network operation, to encourage power aggregation and RES participation in the ancillary service market
- Increased system observability in distribution grids should be achieved
- New assets (such as STATCOMs) integrated into the system can be crucial to meet TSO and DSO mutual needs
- Flexibility share from different types of flexible resources can give strong regulation capability across the entire day
- DSO must optimise the distribution network, both for its own scopes, and to satisfy TSO requests, exploiting new SCADA functionalities and an advanced Smart Grid infrastructure.
- For efficient and effective DSO/TSO coordination, the process for flexibility selection and activation should be automated, as far as possible.
- Forecasting, optimisation, control logic, as well as reliable communication systems, are needed to enable utilisation of assets in flexibility markets.

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