ABB Smart Lab

Simulation and research into components, systems and services for the digitalization of power grids and industrial plants

- Latest technology trends demonstrators
- Functioning systems made with components that simulate the real use in the field
- Interactive demos to show benefits of digitalization for power grids and industrial plants

The Laboraty

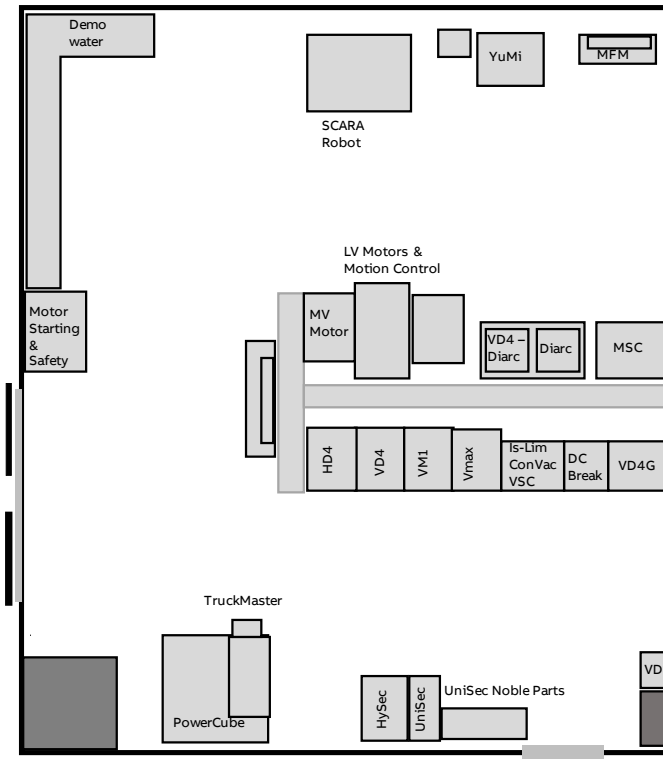
The Lab

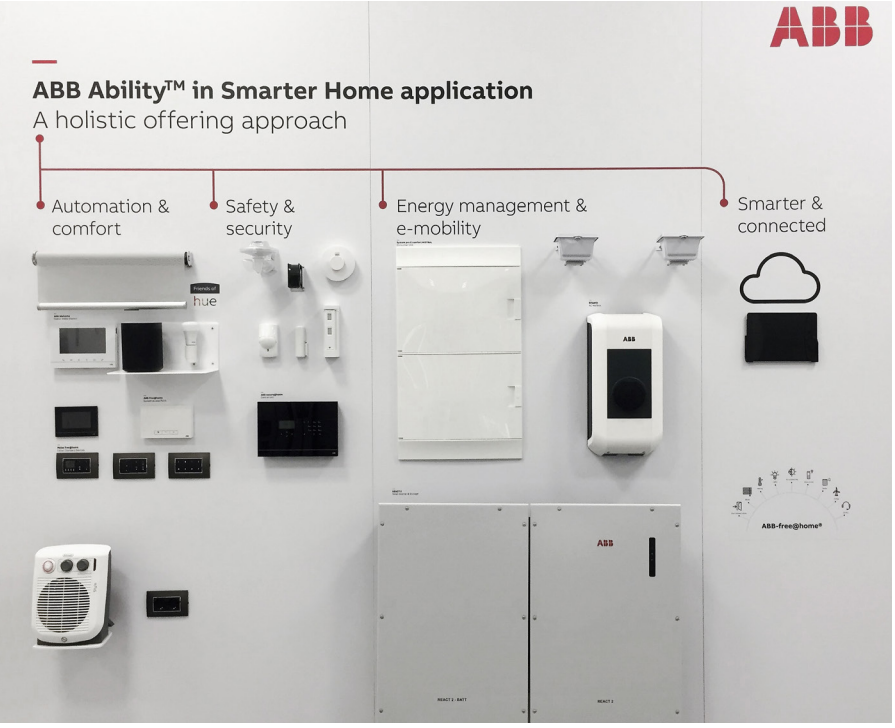
ABB Dalmine Smart Lab, inaugurated in May 2015, is a unique facility where the most pioneering technologies are experimented, researched and simulated. The lab demonstrates the integrated operation of a vast range of products and systems for electricity transmission and distribution and for industry, the majority of which are manufactured in the Italian factories belonging to the ABB Group.
Thanks to different types of installed and interconnected components, technicians can simulate the behavior of electric distribution networks, the components and systems of industrial plants, naval applications and home automation installations, data centers, management of installed systems, energy efficiency and e-mobility.

Solutions

Upgraded to the latest technological trends, the solutions presented in the lab allow tests and simulations to be performed for the purpose of assessing how ABB's components, systems and expertise enhance industrial processes and improve the way high, medium and low voltage power grids operate meeting the different requirements of utility companies, industries, infrastructures, research centers, etc.

Smart Lab- Suimulation area and technolgies



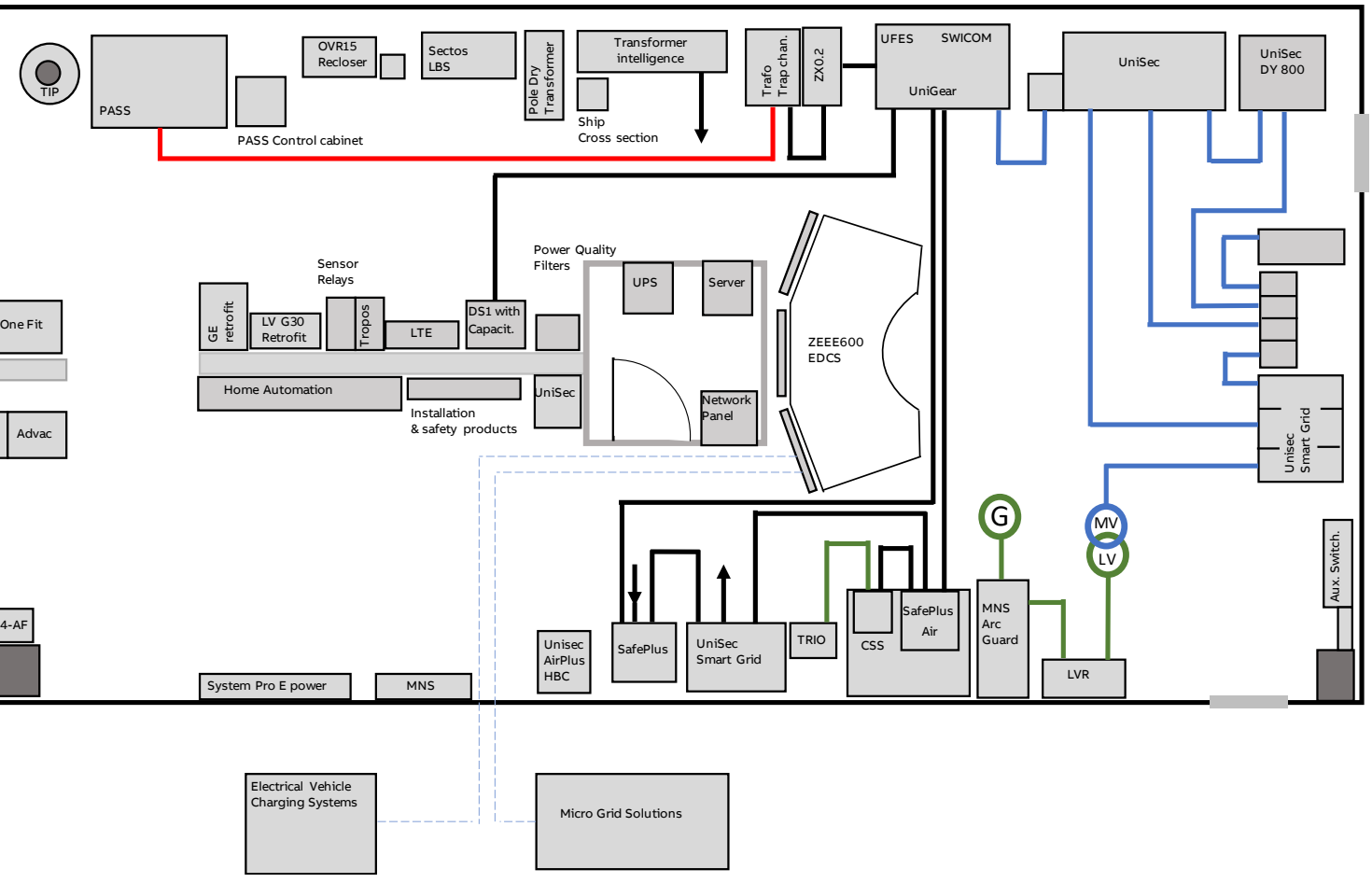


Energy and automation

The devices, systems and software available allow technicians to explore solutions most able to keep pace with the rapid evolution of large sectors in the energy and automation industries both including new interconnections and communication technologies and contributing towards the development of instrastructures for tomorrow's Smart Cities. Research and experimentation into the ways components can be integrated are performed for the purpose of:

- Creating smart grids
- Improving energy efficiency
- Managing the EV Charging Infrastructure
- Monitoring components and eletrical and industrial installations
- Integrating the devices through IoT technologies

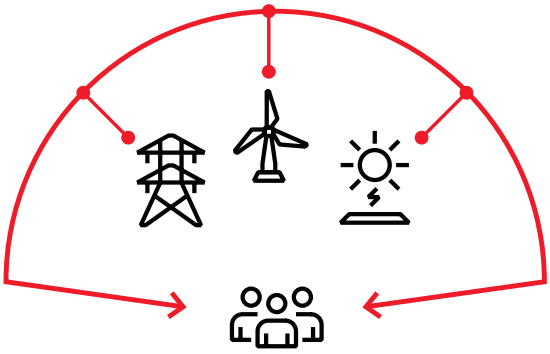
- Monitoring liquids and gases in process systems and multiutility networks
- Managing robots in factory installations



Simulation and behaviour of power grids

Power grid structure

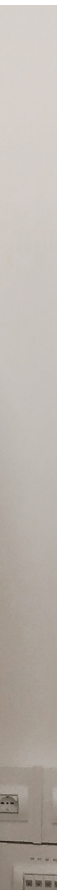
The power grids simulated in the Smart Lab, both meshed and radial distribution networks, comprise contributions from renewable energy sources and include medium/low/high voltage transformer stations.



Conventional distribution networks feature a one-way power flow, where energy is drawn from high voltage power transmissions networks so as to supply the end users.

Smart Grid

ABB's Smart Lab shows a Smart Grid simulations. The significant increase in distributed energy leads to power grid management being switched from "passive" to "active".
This evolution is internationally known as Smart Grid, a term which stands for strongly automated and innovative networks that guarantee high-level reliability, flexibility and accessibility and are able to deal with the many problems linked to a massive use of renewable energy sources.
The fundamental characteristics of Smart Grids is pervasive use of communication technology for metering and remote control. The most widely used protocol is IEC61850, the international standard for electrical system automation which allows vertical communication towards the system (e.g. with the control room of a substation) and an horizontal communication among the various devices in the network (e.g. among the relays in the same substation and among the relays in different substations) using G.O.O.S.E. texts (Generic Object Oriented Substation Event).



Simulations

The Smart Lab technicians can simulate the behaviour of power grids in different conditions:

- Normal or stand-alone operation
- Presence or absence of distributed energy at different levels of productions
- Load connection and disconnection levels
- Possible faults in different grid line sections

In all these cases, the protection and automation apparatuses function on the basis of signals generated according to mathematical models, but they operates just as they were in a real network. This allows the different viable solutions to be tested to see how they react to each type of situation and to immediately identify the most effective ones.

The mathematical models, which are the heart of the simulation system, are kept up to date thanks to collaboration with research centers and universities worldwide, on the basis of new situations which continue to occur in modern power grids.

The lab also has devices for communication among several substations. This allows new applications based on data exchange to be created and simulated so as to improve fault handling and enhance the overall reliability of the network. These technologies will increasingly be subject to practical application in the future.

ABB'S Smart Lab contains components and systems such as:

- Water and gas sensors
- SCADA systems
- PLC modules
- Motors
- Drives
- Inverters for photovoltaic systems
- Storage devices
- Robots
- Charging stations for electric vehicles
- Medium and high voltage apparatus and transformers
- Current and voltage sensors
- Low voltage components and systems
- UPS for data centers
- All the communication systems commonly used by Smart Grids and their relative monitoring systems, etc.

Automation and communication systems

Power grid behaviour

If a fault occurs in one of the peripheral branches of a conventional network, protection tripping may propagate to higher level branches. This results in outage in large areas of the power grid which will take much longer to put right and increase the penalties applied by the Supervisory Authority that monitors the quality of the energy distribution service.
This is an increasingly topical issue for public utility companies, which are now obliged to manage a greater number of interconnections and unplanned supplies from distributed energy systems that can interfere with and impair the stability of the entire power grid if faults occur.

Tests and simulations in the grids

Tests and simulations in water supply networks
Smart Lab has a water supply network simulator with a hydraulic circuit that really works and is composed by all the main ABB equipment for metering, monitoring and regulating the fluids.

The circuit has its own water tank operated by motors and inverters which allow:	the pressure trends to be simulated in real time and the flow rates to be adjusted by valves
	to monitor the energy saving levels of the inverter-motor-pump assemblies as well as directly assessing the advantages of these systems in the water supply networks of our cities or industrial installations
Tests and simulations of robotized solutions, management of peak energy demands and a home automation demo	
Smart Lab has functional components with which it is possible to:	interact, like the latest generation robot and a simulator that demonstrates all the potential of Power Management devices that allow prudent management of simultaneous load conditions, thereby optimizing grid use and sizing and the actual supply contract
	understand how these technologies not only offer energy efficiency but all the advantages of remote control in our homes

Digitalization of networks and Industry 4.0 applications

Smart Lab has a wide range of sensors which allow data to be collected from the various devices. Sensors are truly connected via communication networks that collect data which are analyzed by algorithms and transformed into useful information for plant management, maintenance and process optimization.

Communication networks

To ensure that power grids become even more reliable, the techniques for using Information Technologies must be researched to a further extent and tested before they can be used in real projects. The Smart Grids lab provides a communication structure based on both wireless and Ethernet private networks and on public networks like GPRS or LTE.

This means that the efficiency of network selectivity and protection automations can be assessed by means of different communication media.

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