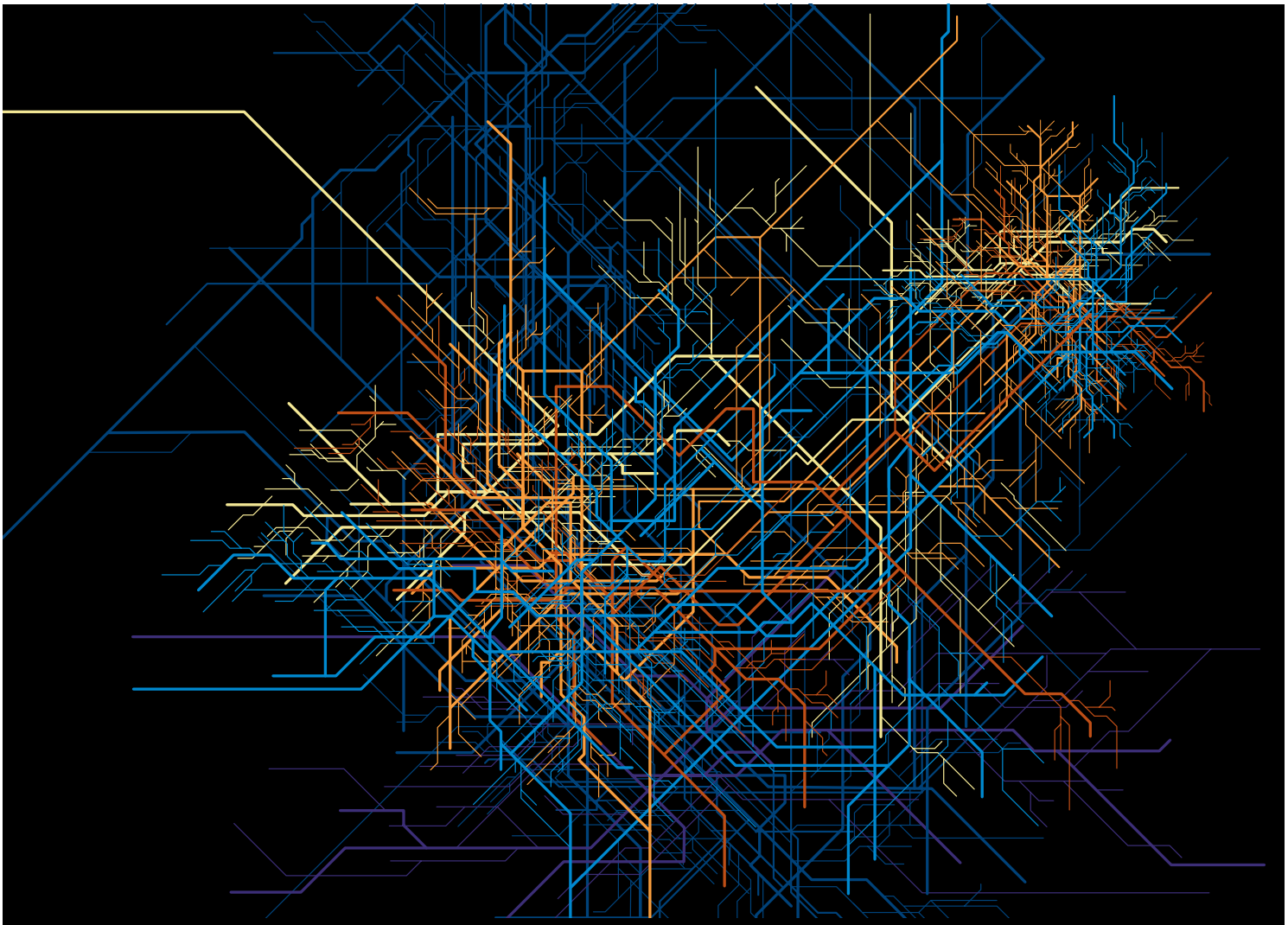
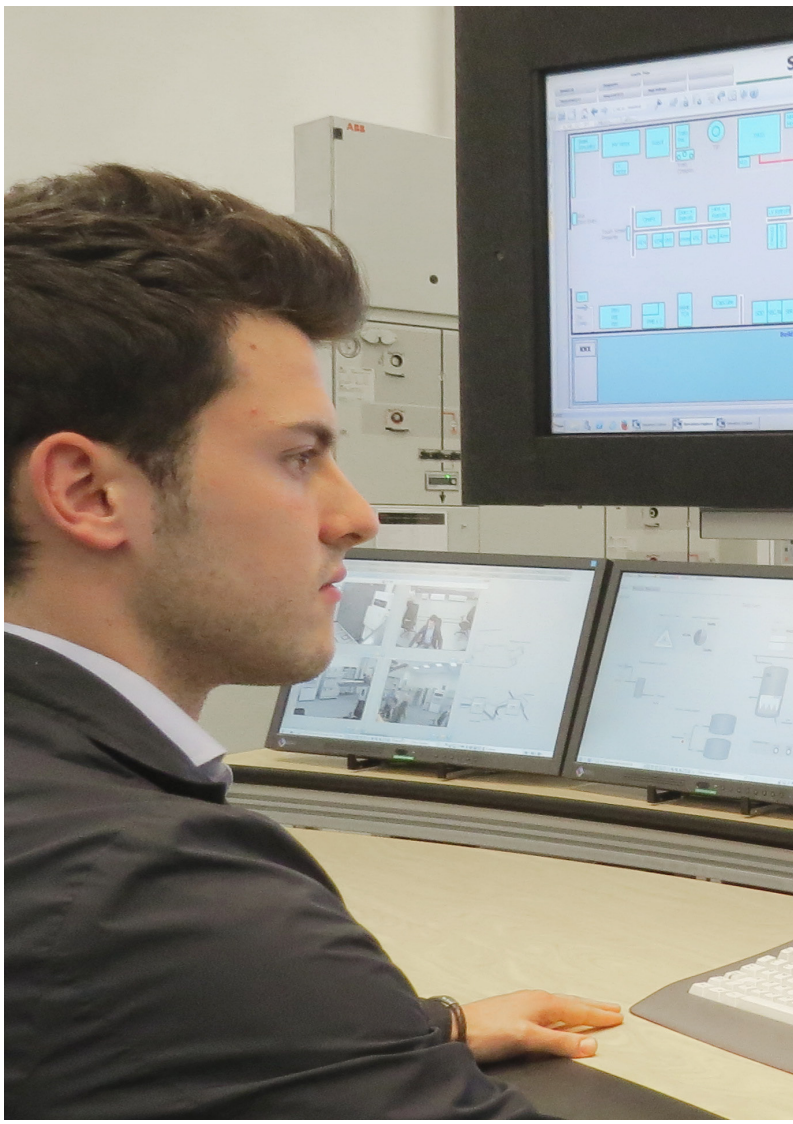


Smart Lab ABB
Simulation and research into components and systems for power grids and water supply networks

Power and productivity
for a better world™

The Lab

ABB's Smart Lab in Dalmine 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 13 Italian factories belonging to the ABB Group. Thanks to different types of installed and interconnected components, technicians can simulate the behaviour of radial, meshed and rural electric distribution networks, the components and systems in home automation installations, data centers, management of installed systems and energy efficiency.



Solutions

Upgraded to the latest technological trends, the solutions presented 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, thereby meeting the different requirements of utility companies, industries, infrastructures, research centers, etc.

Energy and automation

Research and experimentation into the ways components can be integrated are performed for the purpose of creating smart grids, but also for improving energy efficiency in industries, buildings and Data Centers, for monitoring liquids and gases in process systems and multiutility networks and for managing robots in factory installations. 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 by including new interconnection and communication technologies and contributing towards the development of infrastructures for tomorrow's Smart Cities.

Simulation and behaviour of power grids

Power grid structure

Conventional distribution networks feature a one-way power flow, where energy is drawn from high voltage power transmission networks so as to supply the end users.
The power grids simulated in Smart Lab comprise contributions from renewable energy sources. The simulations involve both meshed and radial distribution networks and include medium/low voltage transformer stations.

Definition of a Smart Grid

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 characteristic 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 horizontal communication (e.g. among the relays in the same substation and among the relays in different substations) among the various devices in the network using G.O.O.S.E. texts (Generic Object Oriented Substation Event).

Simulations

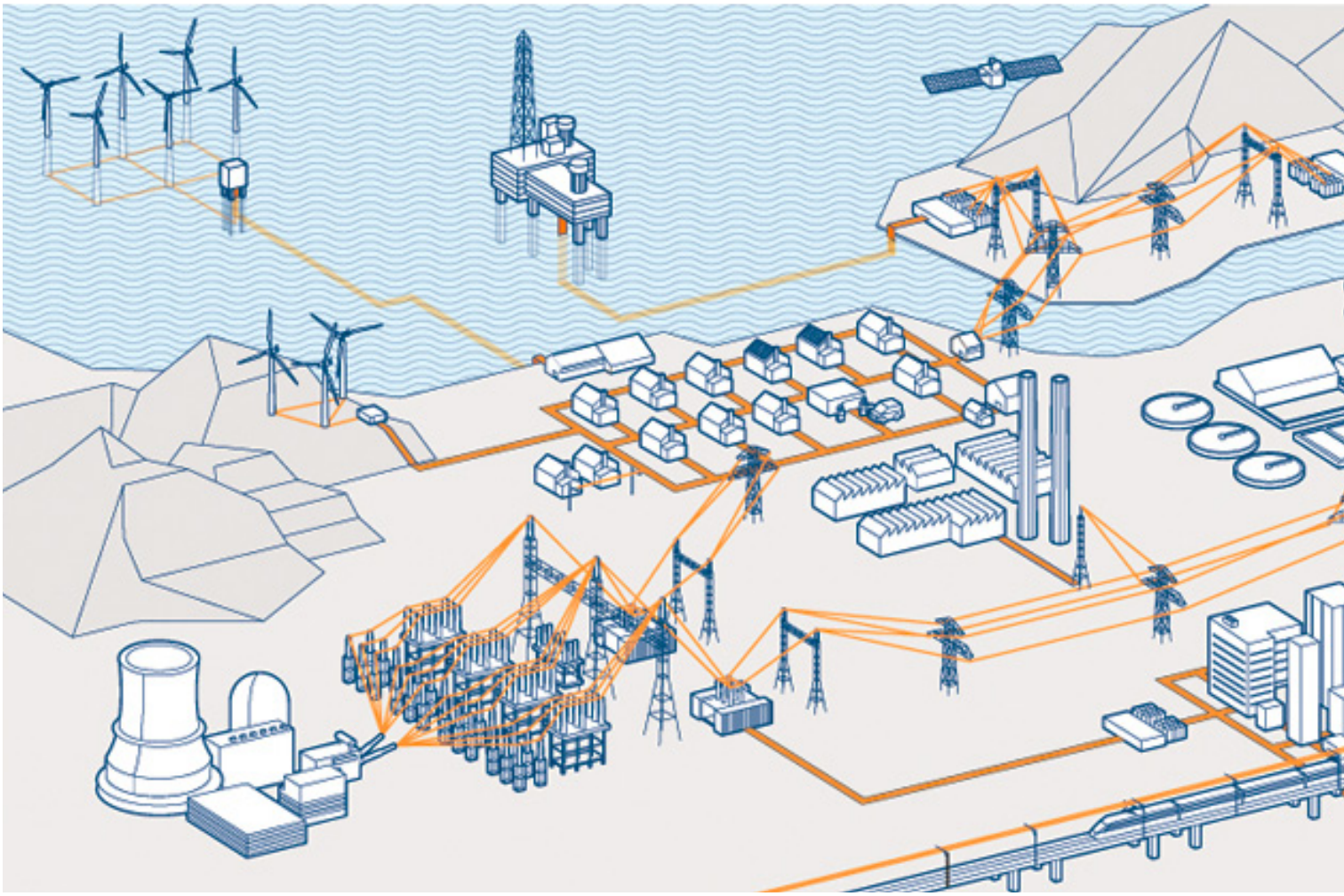
ABB's Smart Lab contains components and systems such as: water and gas sensors, SCADA systems, PLC modules, motors, drives, inverters for photovoltaic systems, storage devices, robots, charging stations for electric vehicles, medium and high voltage apparatus and transformers, current and voltage sensors, low voltage components and systems, UPS for data centers, all the communication systems commonly used by Smart Grids and their relative monitoring systems, etc.
The 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 production, load connection and disconnection levels, 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 operate just as though 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 pinpoint any improvements required.
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, which have not yet been used in the existing distribution networks, will certainly be subject to increasing practical application in the future.

Automation and communication systems

Power grid behaviour

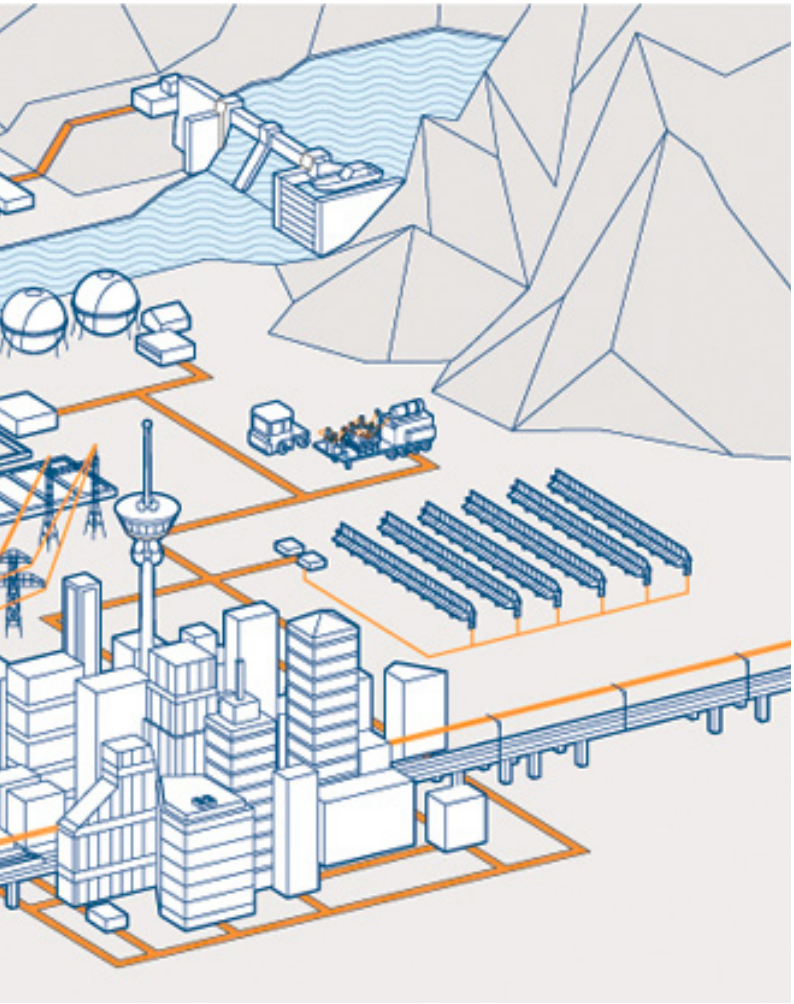
If a fault occurs in one of the peripheral branches of a conventional network, protection tripping may propagate to higher level branches. This results in outage in large areas of the power grid which will take much longer to put right and increase the penalties applied by the Supervisory Authority that 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 all the main ABB equipment for metering, monitoring and regulating the fluids. The circuit has its own water tank operated by motors and inverters allowing the pressure trends to be simulated in real time and the flow rates to be adjusted by valves.



Besides automatic management of the hydraulic circuit parameters in real time, the lab technicians can also 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. By interacting with the home automation demo system, users can see how these technologies not only offer energy efficiency, but all the advantages of remote control in our homes.

Network reliability

Being offered a facility where they can test components and configurations in a flexible and dynamic way allows Smart Lab visitors to create real network conditions, study specific situations, simulate different energy flows and even faults. In short, it allows them to understand which components to use and which decisions to make so as to guarantee that the power grids are managed as accurately as possible.

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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