

Securing your power supply

Change-over and transfer switches for Critical Power applications

Power and productivity
for a better world™



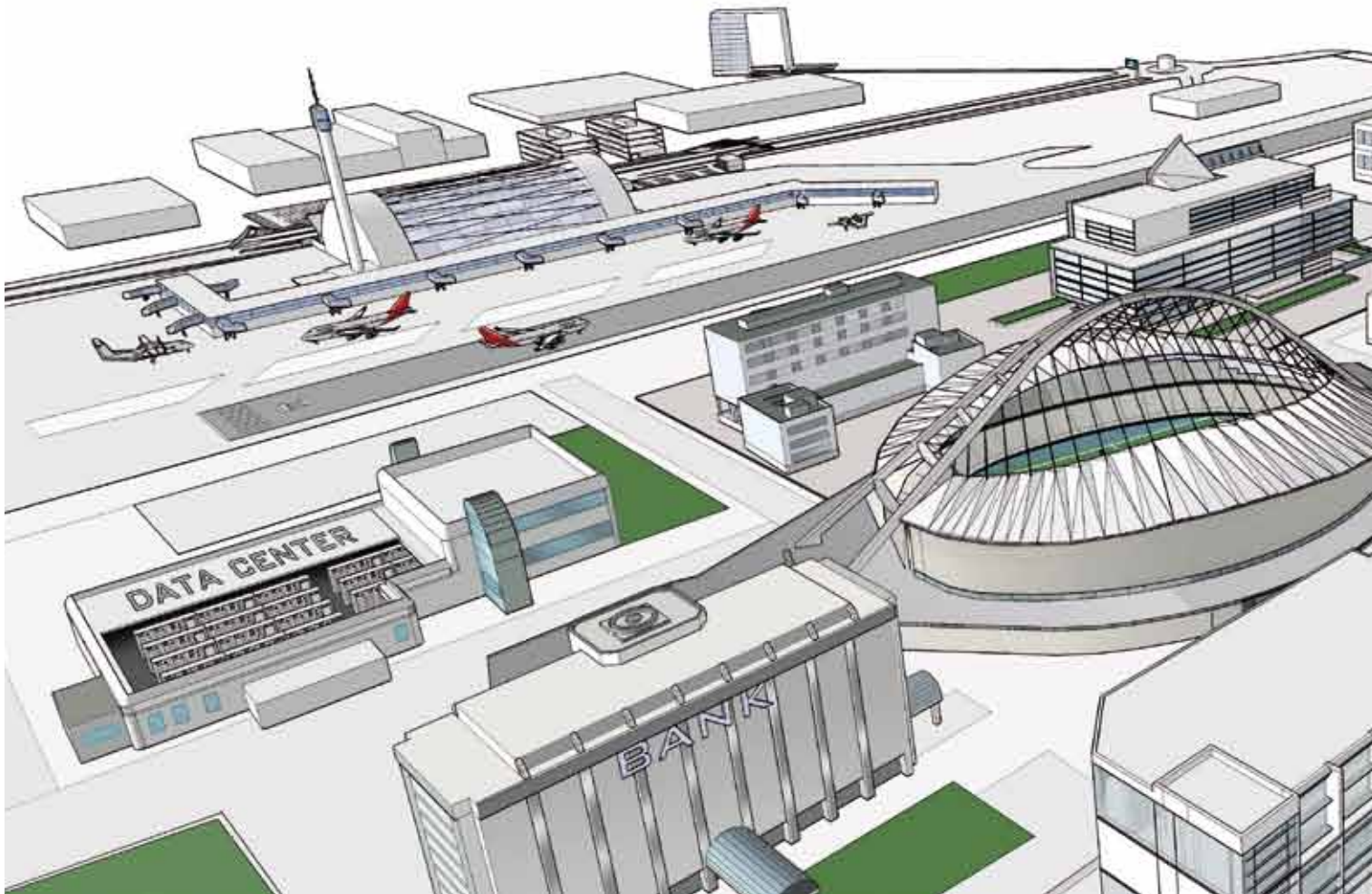
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Constant commitment

ABB's solutions and products to ensure continuity of operation

Critical applications require a constant and reliable power supply to keep fundamental services running and prevent serious consequences due to interruption or absence of the electrical grid. This need is even stronger nowadays because of the increasing significance of key role, capacity and features of these systems. In order to ensure the high level of reliability requested, the system must include generators and UPS equipment which ensure the right power supply to the critical loads in case of grid failure.



In today's world, electrical power plays a key role in almost every activity of our life. For some equipment a reliable, uninterruptible and free of disturbance power supply is an absolute need.

From this point of view, a fault in the power supply of communications systems, hospital apparatus, security systems, water and gas distribution devices, banking computers and many other crucial appliance may bring about serious problems, with consequences that can easily be imagined.

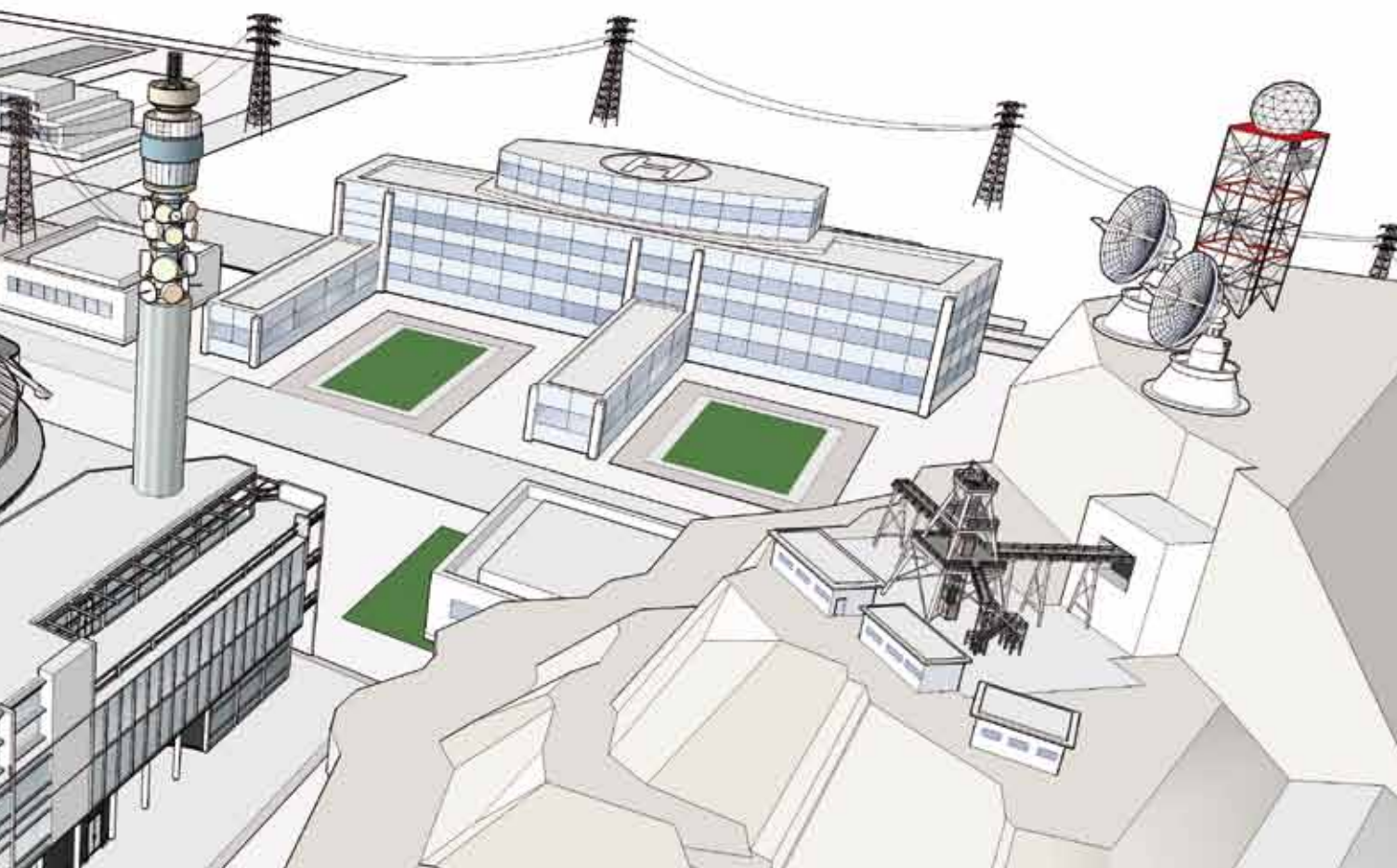
All these applications can be identified as "Critical Power" applications: they are specifically designed to leverage a constant and secure power supply, for example using UPS equipment or power generators.

In the area of "Critical Power" ABB can offer a wide range of products, including both components for on board installation and complete power distribution systems.

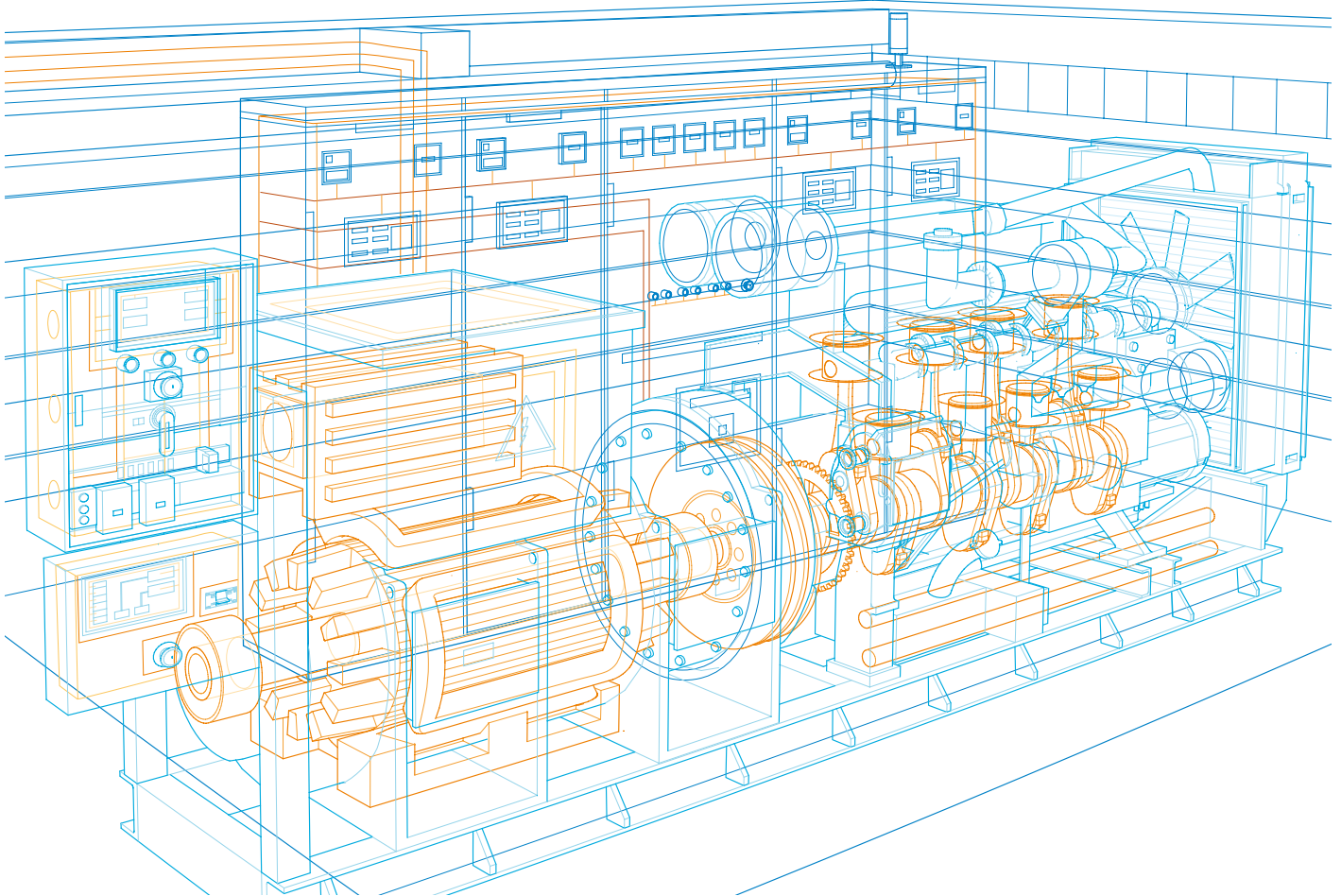
These products range from low voltage generators for generator sets (Gen-set) to iPDU (intelligent Power Distribution Units) switchboards, and include all types of equipment specifically required to provide safety and reliability: air, moulded-case and miniature circuit breakers, protections against overvoltages, isolators and switch-disconnectors, contactors, manual and motorized change-over switches, automatic transfer switches and automatic control units, current sensors and many other devices.

ABB products comply with the most important international standards - either European or North American - and with the requirements of the Navy Registry; they are also designed and built on the basis of the most modern and advanced environmental standards.

ABB products are backed by a consolidated experience in power and automation technologies. They are supported through a global assistance and service network which covers more than 100 countries all over the world.



Never ending reliability Generator-set application



Generator-set

A generator set (Gen-set) is fundamental in many Critical Power applications where a constant and reliable source of electrical energy is required.

Such a power source may be placed at various levels in a distribution network, wherever there are “critical power nodes” - industrial or service facilities, data processing centers, small structures, and even individual items of machinery or devices that are of paramount importance for the plant to which they belong - or when environmental conditions don't allow a reliable connection with the electrical grid.

A Gen-set provides continuous, standby or emergency power when the primary source fails or there's no chance to connect the main grid. The most common applications of a Gen-set are related to key areas where is essential protect the security and the safety of people, services and assets, such as residential buildings, commercial premises, hospitals, schools, telecommunication facilities, industrial sites, mines, off-shore platforms, marine installations, airports, military installations, car parks, galleries, sport installations, auxiliary power stations and many other critical environments. ABB has a long and successful history of designing and

building generators for all power generation applications. ABB has modern products, experience and resources needed to support plant builders and operators from the initial project concept through design, installation and management. Today, ABB is the market leader in generators powered by gas and steam turbines, gas and diesel engines and wind turbines. It has extensive applications experience coming from thousands of installations around the world. ABB also supplies generators for concentrated solar and geothermal installations, other renewable energy applications and energy recovery expanders.

ABB generators achieve the highest standards of efficiency and reliability. They are available over a wide range of operating parameters and enclosures, complying with all internationally accepted standards.

ABB also offers complete sets of generator control equipment as well as upgrades for existing equipment.

A Gen-set solution is a combination of an electric generator (alternator), a combustion engine and an auxiliary and control logic. The function of this system is to provide electricity to a load which cannot be powered from the main grid at that time due to an equipment failure, connection absence,

maintenance or environmental troubles.

The electrical power is generated by the combustion engine – usually diesel, gas or hybrid fuelled. The crankshaft of the combustion motor is connected to the rotor of the generator, exploiting the laws of electromagnetism to convert kinetic energy into electrical energy.

In addition, the Gen-set is usually equipped with a speed regulator (to maintain the frequency of the voltage within limits), a voltage regulator and possibly a programmable control unit which regulates the switching from the network to the group and vice versa.

The Gen-Set is connected to the load through manual, motorized or automatic transfer switches (ATS) which change the source of power - primary or Gen-set - as needed.

The role of the change-over switch

One of the key functions related to a Gen-set is the change-over switching when the main power source fails.

This function is maintained with a change-over switching device according to IEC 60947-6-1 norm. The change-over switch is typically a dedicated switching device, consisting of two mechanically interlocked switch-disconnectors and a motor operator for electrical operation. The switching device might also have an integrated automatic control unit, enabling a full automatic operation of the switching device. Therefore the change-over switches can be operated manually or electrically by using an electric motor.

This solution also fulfills the requirement for making and withstanding short-circuit currents (Class PC equipment).

Usually, the switch has three positions:

- Position I: load connected to the line
- Position II: load connected to the Gen-set
- Position 0: intermediate position which ensures that the load is never connected to both power sources; can eventually be used to isolate the load from both sources

When the load is properly powered by the main source, the switch remains in “I” position.

A control unit processes the signals coming from the voltage sensors.

Sensors normally monitor if voltage amplitude, frequency and other parameters on the load fall within predefined limits.

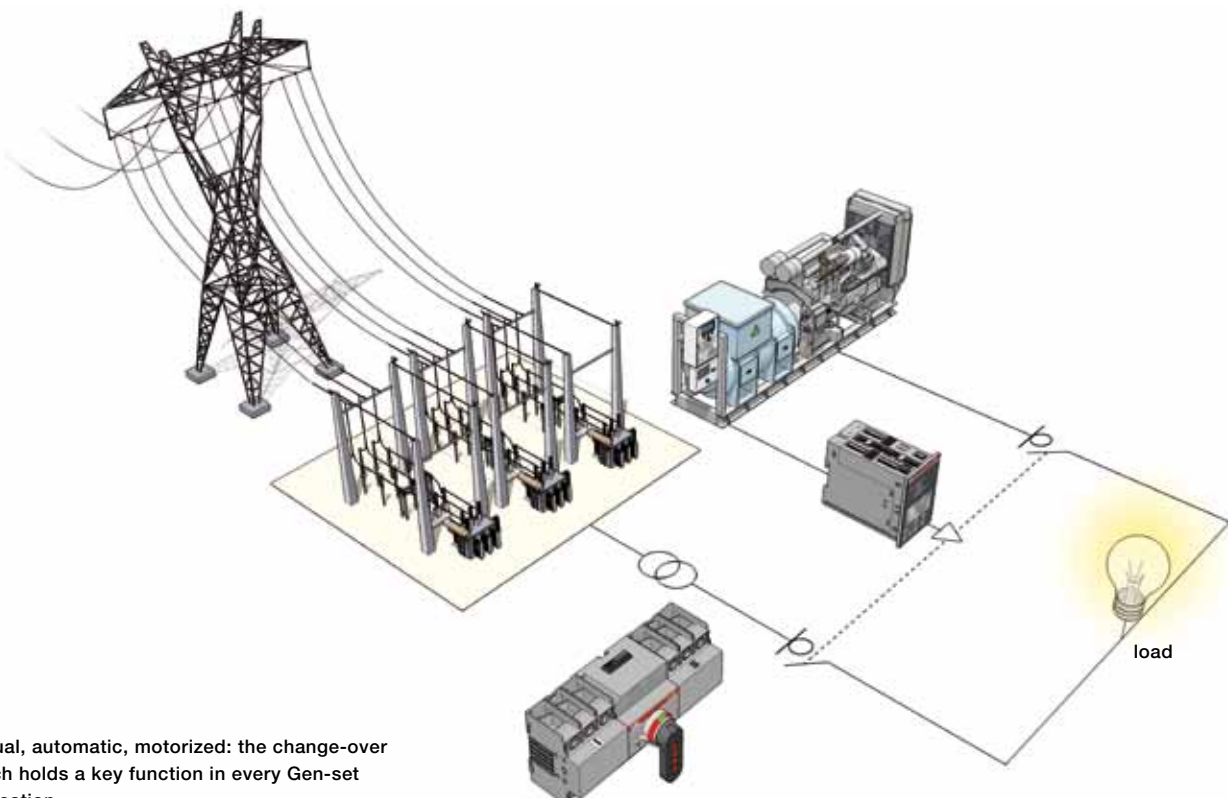
When the control unit detects a fail condition, it sends a command and speed stability after a start-up period.

Switching usually does not happen immediately after the failure of the main power: this prevents to power the load with voltage levels and frequencies different from nominal values.

As long as this voltage is not within the thresholds and is not stabilized, the switch remains stationary in position 0 or I.

After the stabilization the switch can change to position “II”.

The load is powered by the generator until the line returns within limits. At this point, the control unit sends a command to move the switch to position I and, after a transitional period needed to ensure a slow cooling, the engine is turned off.



Manual, automatic, motorized: the change-over switch holds a key function in every Gen-set application.

Maximizing availability of Data centers while providing efficiency and reliability

A growing number of private and public businesses have their crucial point in the Data center. Collecting, storing and managing data requires maximum operating reliability to prevent data losses that may have serious consequences.

Data centers with rows of servers storing trillions of megabytes of information operate around the clock to enable organizations to run applications, process information and automate their operations.

In a Data center the energy absorbed by power supply and environmental control is on average 15 to 20 times as much the energy as a normal office of comparable size. All this energy affects plant costs: when you plan an office building, the electrical and mechanical portions usually equal to 15 percent of the investment, but in the case of a Data center this value increases to 70 percent. The ever-increasing demand for computing power also has an impact: with the new technologies between 20-22 kW of power is required for each single rack, compared to 4-5 kW normally needed in the past. In total that represents millions of megawatt hours of electricity a year and going forward, these environments will become one of the main consumers of power in the world. With the addition of more than 5.75 million new servers every year and reported outages costing \$1 million or more per hour, the priorities of this rapidly changing market can therefore be summarized as follows: security, service continuity, economic and environmental sustainability.

How does a datacenter work

A Data center is a facility used to host not only computers, telecommunication systems, IT equipment or storage resources but also a wide spectrum of components related to energy management and environmental control.

A Data center must keep high standards for assuring the availability and functionality of core computing, in order to minimize any chance of disruption and data security violation. This is accomplished through an accurate and integrated design approach which involves facility (building localization and layout), engineering infrastructure (i.e. power and cooling) and technology infrastructure (servers, cabling and so on).

Not only servers

Data centers are some of the most complex structures on earth, full of intricate and interrelated equipment and systems: beyond servers, console and computers a Data center requires fans, pumps, chillers, valves, switchgear, control systems, transformers, PDUs, RPPs, UPSs and many other components which often represent the most of the investment and operating costs. In this scenario, the redundancy of backup power supplies and communications, an accurate environmental control and a tight security policy are the key for maximize the availability of a so crucial resource. And, like all mission-critical installations, also a Data center needs regular monitoring and maintenance to ensure extreme reliability.

Significant amounts of energy can be saved through improvements to Data center equipment, facility design and management, and ABB provides a wealth of expertise, engineering, products and support, to not only help today's Data centers operate more efficiently, but also to operate safely and more reliably.

Data centers need a constant and reliable power supply and an accurate control of environmental conditions to keep services running and prevent any consequences due to interruption or absence of energy.

The role of the change-over switch

The automatic transfer switch shall be managing different power supplies to one or more load circuits and guarantees the continuity of performance. The automatic transfer switch ensures the switching and isolation between the primary power supply and the alternate power supply or standby generator. The type of operation shall be open transition, i.e. break-before-make.

Fully automatic operation ensures that loads are transferred automatically to the secondary source in case of mains failure. Both local operation with the control unit and full automatic operation enables a short switch-off time between the normal and the alternative supply.

In Data centers automatic transfer switches are predominantly used to backup cooling facilities (air-handling units and chillers) on UPS (Uninterruptible Power Supply) that ensures short time power supply in case of emergency.



Maximizing availability of Data centers while providing efficiency and reliability

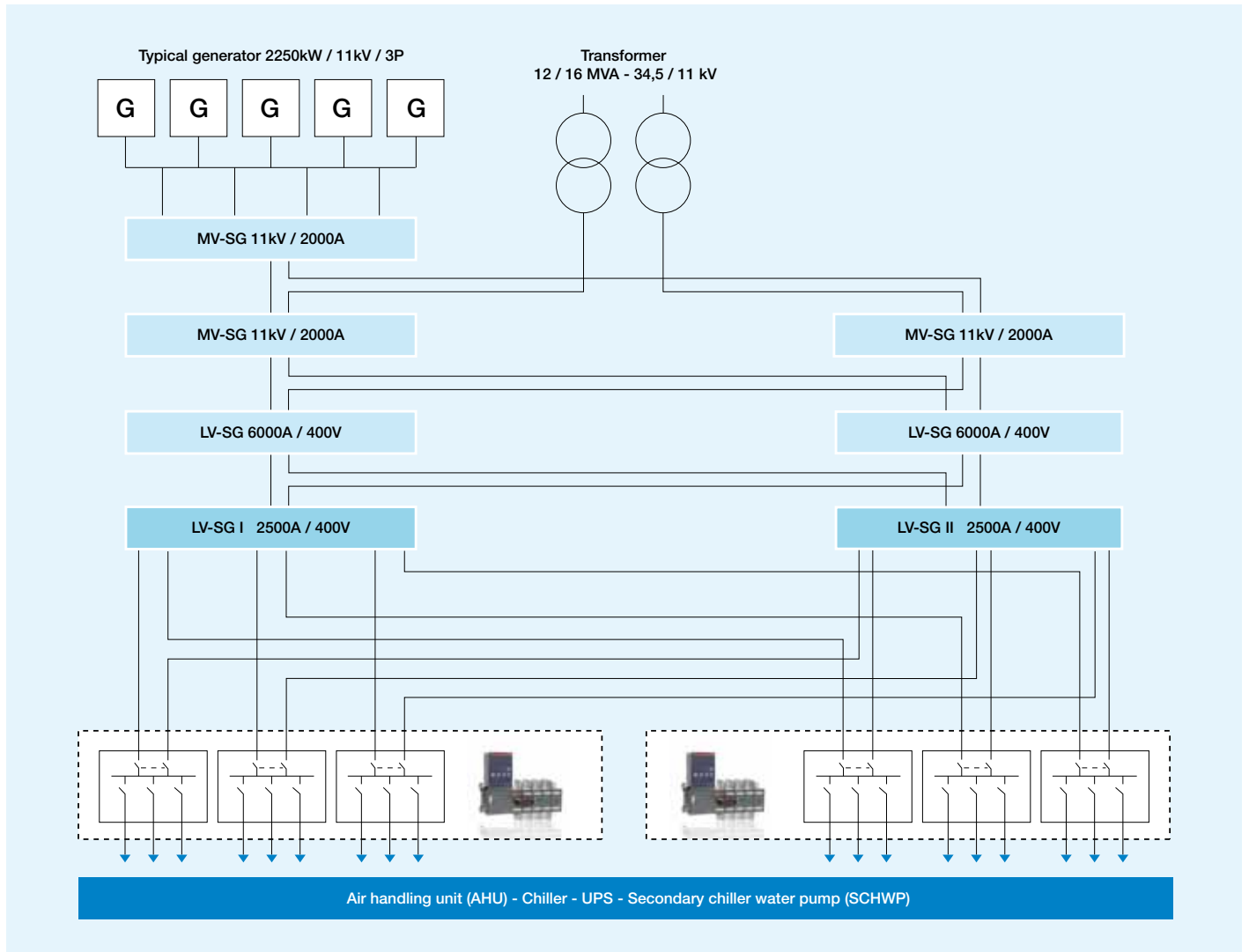


1. - Microgrid connectivity
 - Strategic partner to leading wind and solar OEMs
2. - Substations
 - Transformers
 - Medium-voltage switchboards / switchgear
 - Dry-type transformers
 - Network Communication
 - Generators
 - Power quality assessments
 - HV UPS

3. - Intelligent power distribution units
 - Remote power panels
 - Branch circuit monitoring
 - Strategic partner to leading OEMs
 - AC or DC battery chargers
4. - Low-voltage switchboards / switchgear
 - Circuit breakers
 - iPDUs (Power Distribution Units)
 - Active filter
 - Power factor correction
 - Network Communication

5. - EFF1 high-efficiency motors
 - Inverter
 - Network Communication
6. - HVAC solutions
 - High-efficiency motor
 - Low-harmonic variable frequency drives / inverters
 - Circuit breakers
 - Cooling
 - Automation and control
 - Energy efficiency audit
 - iPDUs (Power Distribution Units)
 - Remote Power Panel
 - Power Measurement
 - Network Communication
 - ATS

7. - i-bus EIB/KNX
 - Network Communication
 - Active filter
 - Power factor correction
 - Rectifier
 - Uninterruptible Power Supplies
8. - Data center automation and power optimization
 - Remote monitoring and diagnostics
 - Automation switchboards
 - Inverter
 - PLC
 - Control Gear
 - Network Communication



In Data centers automatic transfer switches are predominantly used to backup cooling facilities (air-handling units and chillers) on UPS (Uninterruptible Power Supply) that ensures short time power supply in case of emergency.

Critical in every condition

Manual, motorized, automatic: the features of ABB's change-over switches



Every backup generator needs a reliable change-over switch to transfer loads from the primary source to the emergency or standby power system.

ABB provides a complete portfolio of change-over and transfer switches for Gen-set and Data center applications. The range comprises of manual (OTC), motorized (OTM_C) and automatic transfer switches (OTM_C_D).

ABB's range is tested according to IEC 60947-3 and IEC 60947-6-1, assuring correct operation both in normal and emergency conditions.

These products feature many integrated safety features and are particularly suitable for critical power applications, since they guarantee an effective and rapid switchover from main supply to Gen-set during voltage failure.

The three positions that characterize the mechanism of the change-over switches ensure that the two different power supplies always remain isolated; additionally, in the motorized version, the electric control circuit offers further safety: if the motor receives two commands simultaneously, the OFF command always takes priority.

Manual change-over switches

Manual change-over switches are suitable for Gen-set applications where the transfer doesn't need to be done particularly fast. Manual change-over switches can be operated only locally by manual operation so there is a need for manpower to make the transfer. In some cases it can take up to one hour to get a skilled person to operate the switch. The OTC switches for manual change over are available in OTC16...2500_C version and provide open transition switching (I-O-II) and a range of nominal current from 16 A up to 2500 A.

The products are tested for a high number of operations, with safe and separate opening of contacts in all possible positions.

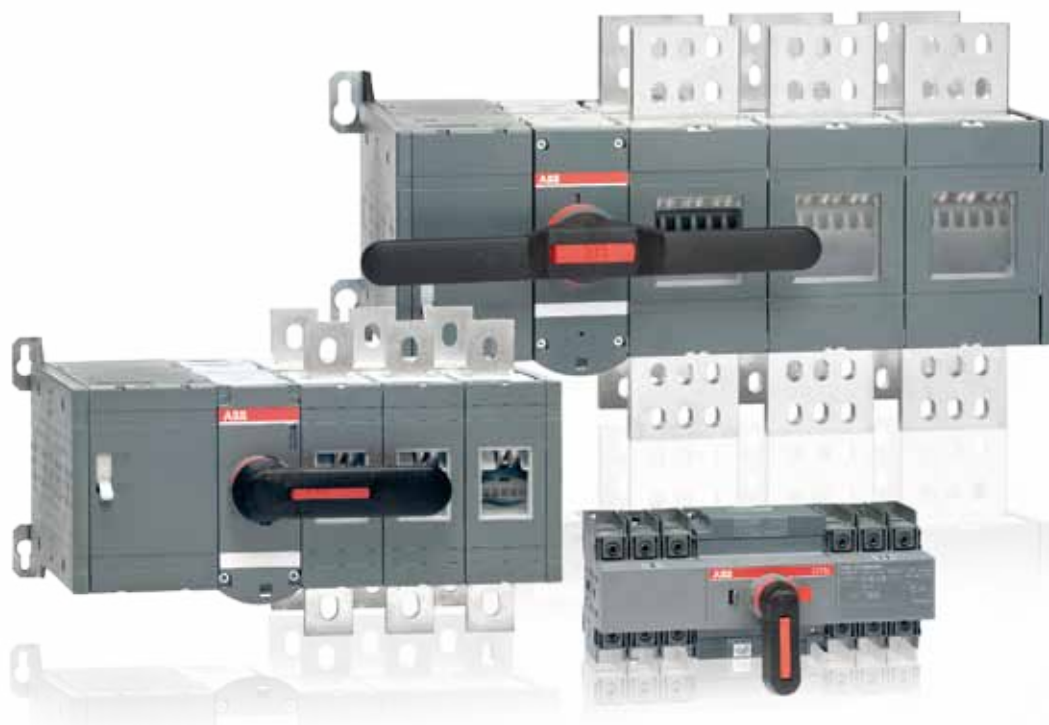
Motorized change-over switches

Motorized change-over switches are required in applications where the transfer must be done quickly after source failure. Thanks to the possibility to command the motor remotely with a PLC or PC-based controller, there is no need for manpower in making the transfer. This means that the equipment can be located in isolated areas or places.

Motorized change-over switches consist of a change-over switch (type OTC) and a motor operator. The ABB's OTM family range from 40 to 2500 A. Switches can be operated either electrically by using the motor operator or manually by using the local handle.

The remote control can easily be prevented by a selector switch "Motor/Manual" on the motor operator. This ensures that maintenance work can be executed safely. Remote control is also prevented whenever the manual handle or a padlock has been inserted.

Products are tested in compliance with the IEC 60947-6-1 standard utilization categories AC-31B and AC-33B.



Critical in every condition

Features of ABB's automatic transfer switches



Thanks to its automatic control unit, which monitors the voltage parameters on the primary supply, the automatic transfer switch is able to start the backup generator and quickly and safely transfer the load to the temporary power. ABB's range of solutions perfectly matches every application need according to international standards

Automatic transfer switches

Automatic transfer switches transfer the load automatically, from one supply to another.

Automatic transfer switches (ATS) are suitable for applications where the transfer must be done quickly after source failure. In this case the motorized change-over switch is operated by an ATS control unit provided by the generator manufacturer or a local panel builder. The generator manufacturer or panel builder does the necessary work to connect the motorized change-over switch to the ATS control unit. They are also responsible for the reliable operation of the equipment. For customers who don't want to design the equipment by themselves an automatic transfer switch provides a ready-made solution.

ABB OTM_C_D series of automatic transfer switches from 160A to 1600A provides an intelligent and fully automatic solution for Gen-set and Datacenter applications.

An automatic switching device can be managed and controlled by PLC or by special electronic devices. ABB can supply the necessary PLC devices (available in the AC500 series).

An ABB ATS solution comprises of a change-over switch, a motor operator and an automatic control unit (OMD). Motorized change-over switches and OMD control units can be used to build different ATS combinations.

The automatic control units (OMD200, OMD300, OMD800) have two sensors to check the supply characteristics of the main and secondary line (voltage, frequency and the phase balance) and send start/stop commands to the generator.

The automatic control units are able to work with single or three-phase lines. The OMD800 version has two-way communication enabling the ATS control unit to be monitored and controlled through the Modbus RTU connection.

The OMD800 has also a graphic display offering user-friendly interface.

ABB's range of ATS products offers nominal currents between 160 A and 1600 A and includes sophisticated features in an extremely compact footprint. Specific features make assembly easy and guarantee safe operations. The change-over mechanism, for example, offers three stable positions which ensure isolation of the two asynchronous power supplies. This eliminates any risk of short-circuit between them, even in the presence of transient voltages. The automatic transfer switch is equipped with handle for manual operation in case of emergency. The design of ABB automatic transfer switch is advanced and compact, allowing installation in confined spaces at considerable savings. The automatic control unit OMD can be adjusted according to the mounting depth of the panel. Voltage sensing kit is preinstalled at the factory thus reducing the expensive and time-consuming installation work. The motor operator of the ATS is protected by a fuse. If the operation frequency is exceeded, the fuse protects the motor, thus saving it from expensive repair work. Furthermore, the ODPSE230C Dual Power Source energizes the motor operator using two lines: the motor operator is automatically energized with the correct voltage whenever power is available in one of the lines. The ODPSE230C is available as an accessory.



Critical in every condition

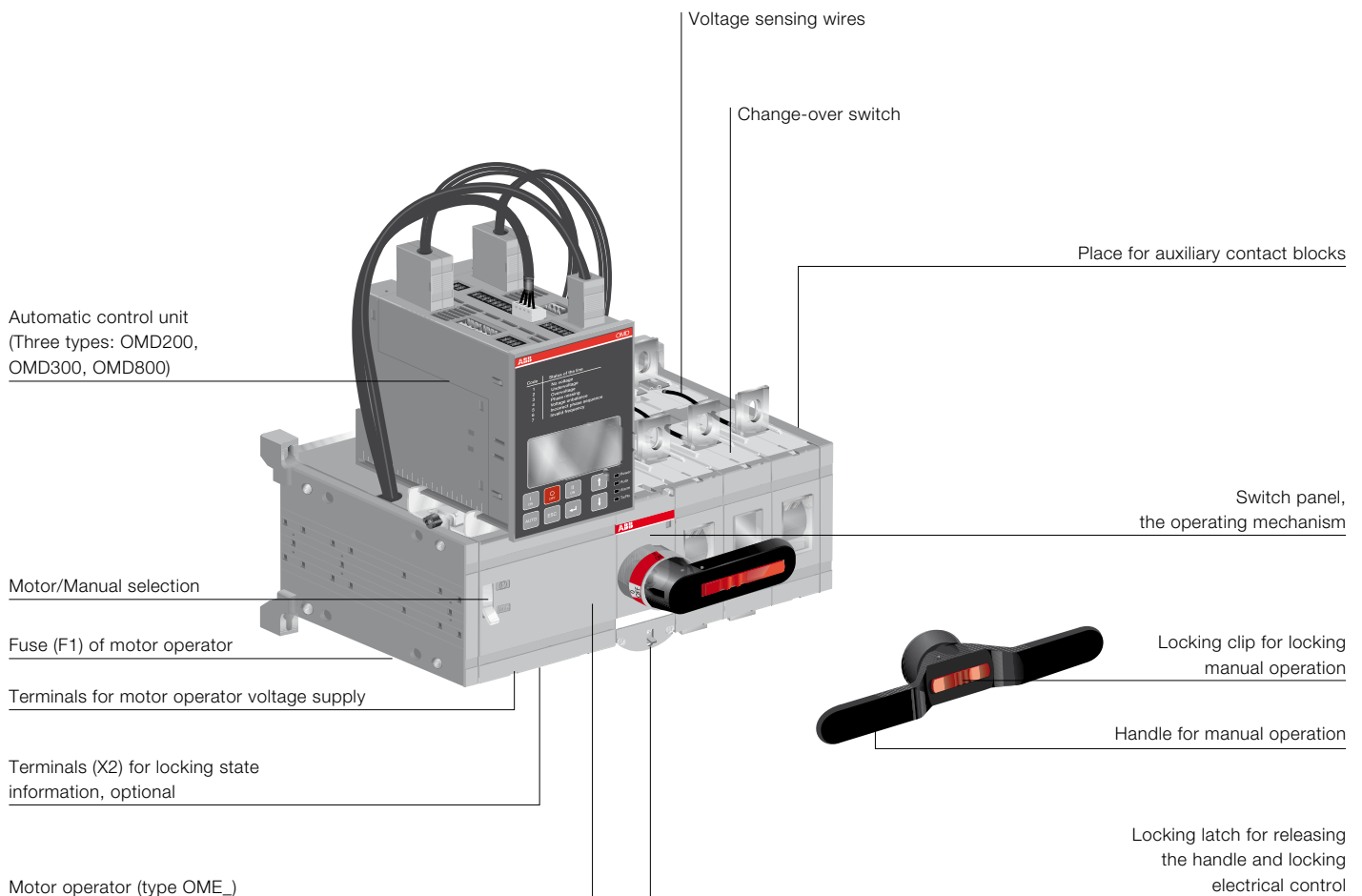
Features of ABB's automatic transfer switches

A wide portfolio of accessories for every application

ABB's change-over products benefit from a wide range of accessories to extend the features and increase safety and security, such as auxiliary contacts, bridging bars, attachment for interlocking, terminal shrouds for finger-safe assembly and many others.

Effective installation

All products are designed to offer an easy, cost-effective layout of the installation. Mounting of the units is allowed in any direction, offering more flexibility to plan the layout of installation. The length of the shaft is adjustable in manual change-over switches, meaning that there is no need to cut the shaft to the precise length. Mounting depth of the automatic control unit can be adjusted by sliding the controller towards the door. Terminal clamps are available for Al and Cu cables while bridging bars allows quick and flexible cabling. Wires are evenly tightened with closing compression contacts. On motorized and automatic versions, clearly marked terminals prevent false connections.



A tailor-made choice

Selection examples

First of all the required operation method needs to be determined. If the transfer time is not very critical and there is manpower available to make the transfer when needed a manual change-over switch is suitable.

If there is no manpower available to make the transfer or the Gen-set manufacturer wants to use their own ATS control unit solution, motorized change-over switches are a suitable choice. An automatic transfer switch is most suitable when a ready-made solution is wanted.

Example 1

Secondly, the correct size of the change-over device needs to be determined. The size of the switch is determined by the load in Amperes or the size of the generator itself in kVA. If the size of the load is already known, for example 370 Amperes selection is easy to make. In this case the suitable size would be 400 Amperes device.

Suitable selections:

- Manual: OT400E03CP (3-poles) OT400E04CP (4-poles)
- Motorized: OTM400E3CM230C (3-poles)
OTM400E4CM230C (4-poles)
- Automatic: OTM400E3C8D230C (3-poles)
OTM400E4C8D230C (4-poles)

Example 2

If the size of the load is unknown but the size of the generator is known, for example 400 Volt generator with maximum output of 500 kVA which makes approximately 720 Amperes

$$500 \text{ kVA} / 0,4 \text{ kV} / \sqrt{3} = 720 \text{ Amperes}$$

In this case the suitable size of the change-over switch would be 800 Amperes.

Suitable selections:

- Manual: OT800E03CP (3-poles) OT800E04CP (4-poles)
- Motorized: OTM800E3CM230C (3-poles)
OTM800E4CM230C (4-poles)
- Automatic: OTM800E3C8D230C (3-poles)
OTM800E4C8D230C (4-poles)

In these examples other control voltage options than 230VAC for motorized change-over switches were not taken into consideration. Also only one type of automatic transfer switch was taken into consideration.

Safety over all

The warranty to choose products complying with all regulations

IEC 60947-6-1

Low-voltage switchgear and controlgear – Part 6: Multiple function equipment – Section 1: Automatic transfer switching equipment.

IEC 60947-6-1 covers all change-over device solutions: switch-disconnectors, contactors and circuit breakers.

Transfer switching equipment is classified according to:

- a) Their short-circuit capability
 - Class PC: capable of making and withstanding short-circuit currents
- b) The method of controlling the transfer
 - Manually operated switching equipment (MTSE)
 - Remotely operated transfer switching equipment (RTSE)
 - Automatic transfer switching equipment (ATSE)

IEC 60947-3

Low-voltage switchgear and controlgear - Part 3: Switches, disconnectors, switch-disconnectors and fuse-combination units

IEC 60947-3:2008 applies to switches, disconnectors, switch-disconnectors and fuse-combination units to be used in distribution circuits and motor circuits of which the rated voltage does not exceed 1 000 V a.c. or 1 500 V d.c.

IEC 60947-3 vs. 60947-6-1

Motorized change-over switches

- IEC 60947-3, for switches, disconnectors, switch-disconnector and fuse-combination units
- IEC 60947-6-1, for transfer switching equipment, the right change-over switch standard



Customer case

OTM switch disconnectors support Pramac generators the world over

The delicate process of transferring loads from the distribution network to the backup generators in emergency situations requires components of first-rate technology and reliability. This is why Pramac chose ABB as a technological partner. ABB is able to supply quality and total assistance in all areas of the world.



Pramac supplied 44 electricity generators for the lighting system of the Abu Dhabi Formula 1 Grand Prix track. Each one has electrical power from 250 kW to 370 kW and is able to supply enough power to light more than 4,000 flats. Pramac generators are equipped with special anti-sand filters able to prevent any potential blackouts caused by desert sand storms.

The PRAMAC Group of Siena develops, manufactures and sells a wide range of generators (1 kW to 3 MW) all over the world. ABB OTM motorized change-over switches disconnectors are used in the Load Transfer Solution (LTS) network switchboards, which are supplied separately with external logic. The complete system, consisting of a control panel and an LTS network switchboard, supervises the distribution network and automatically starts the motor when a problem occurs, so that within a few seconds the load is powered by the generator.

The choice to use the ABB OTM products was made for a number of reasons. In looking for a technological partner, international leaders such as ABB were favored. That is to say, companies able to provide pre- and aftersale support in all contexts where PRAMAC generators are used.

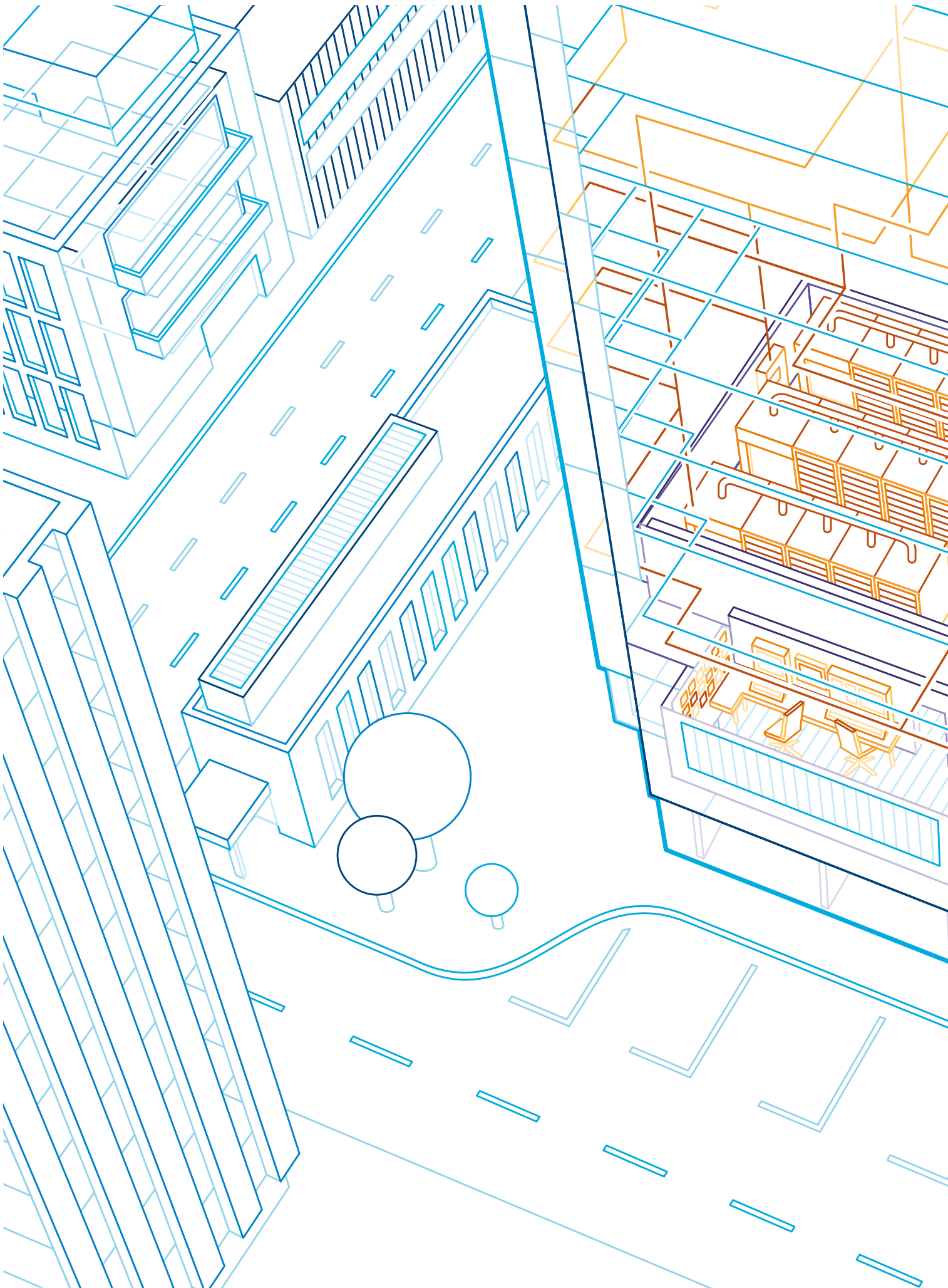
It was then basically the presence of the double sectioning solution in the ABB offer that decided the choice, since it guarantees higher levels of protection against the risk of electric arcs that are disconnected in two points instead of one. This prevents the contacts from sticking and the relevant

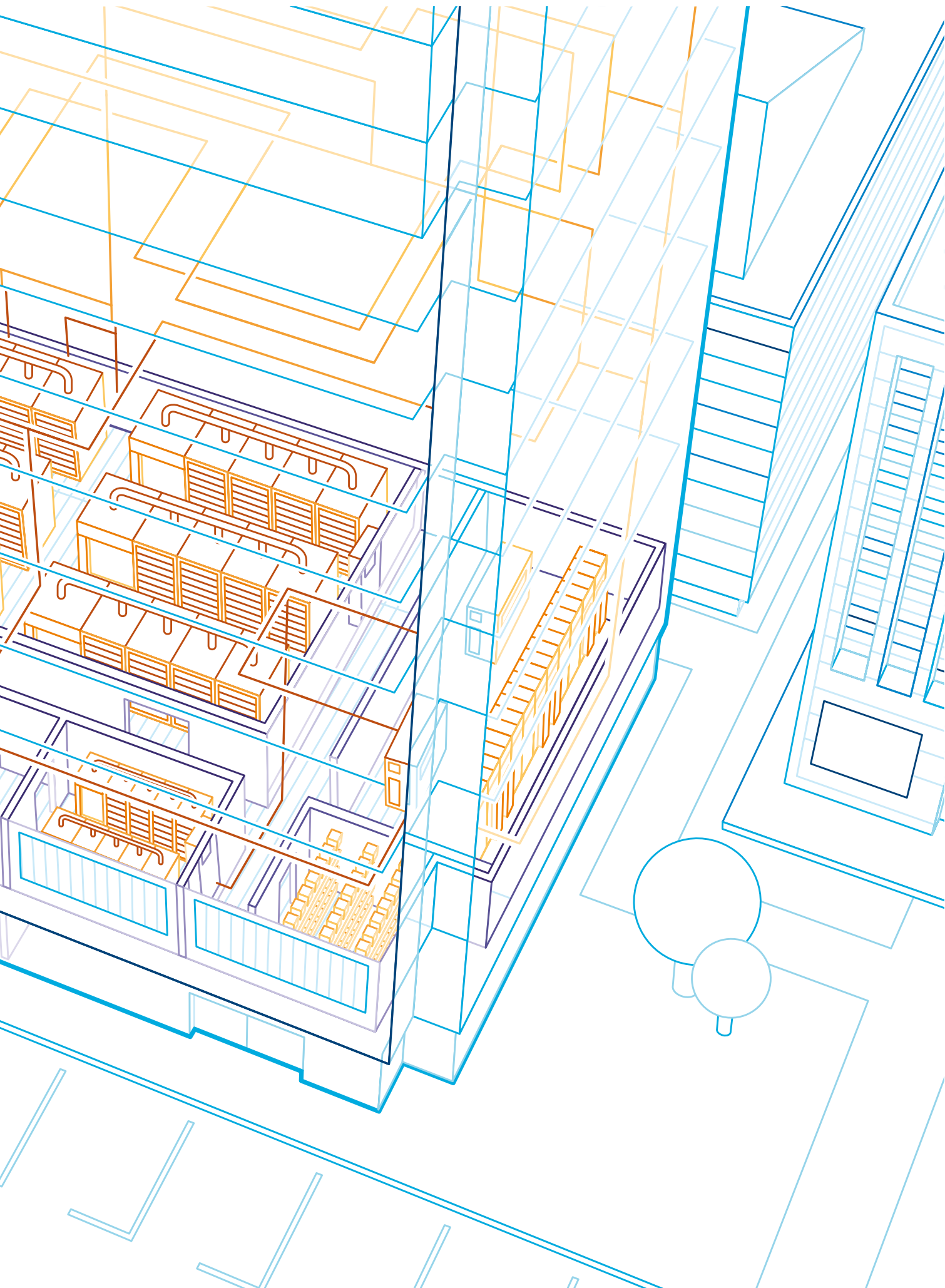
risks for equipment and personnel.

Another important advantage lies in the presence of an intermediate stable 0 position. This technical feature makes it possible to disconnect from the network when necessary because it is unreliable in that moment – even during the starting phase preceding generator connection. Other factors, none the less important, were the completeness of the OTM range, specifically designed for use with generators, in addition to its reliability and intrinsic quality. Worthy of note is the fact that the OTMs are produced in such a way as to minimize the micro-recoils of the contacts during the operation phases. This contributes to significantly improving their reliability and preventing the chance that they create electric arcs so that potential problems for people and equipment are avoided.

Last but not least, their compactness is a key factor, which has allowed panel sizes to be reduced.







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