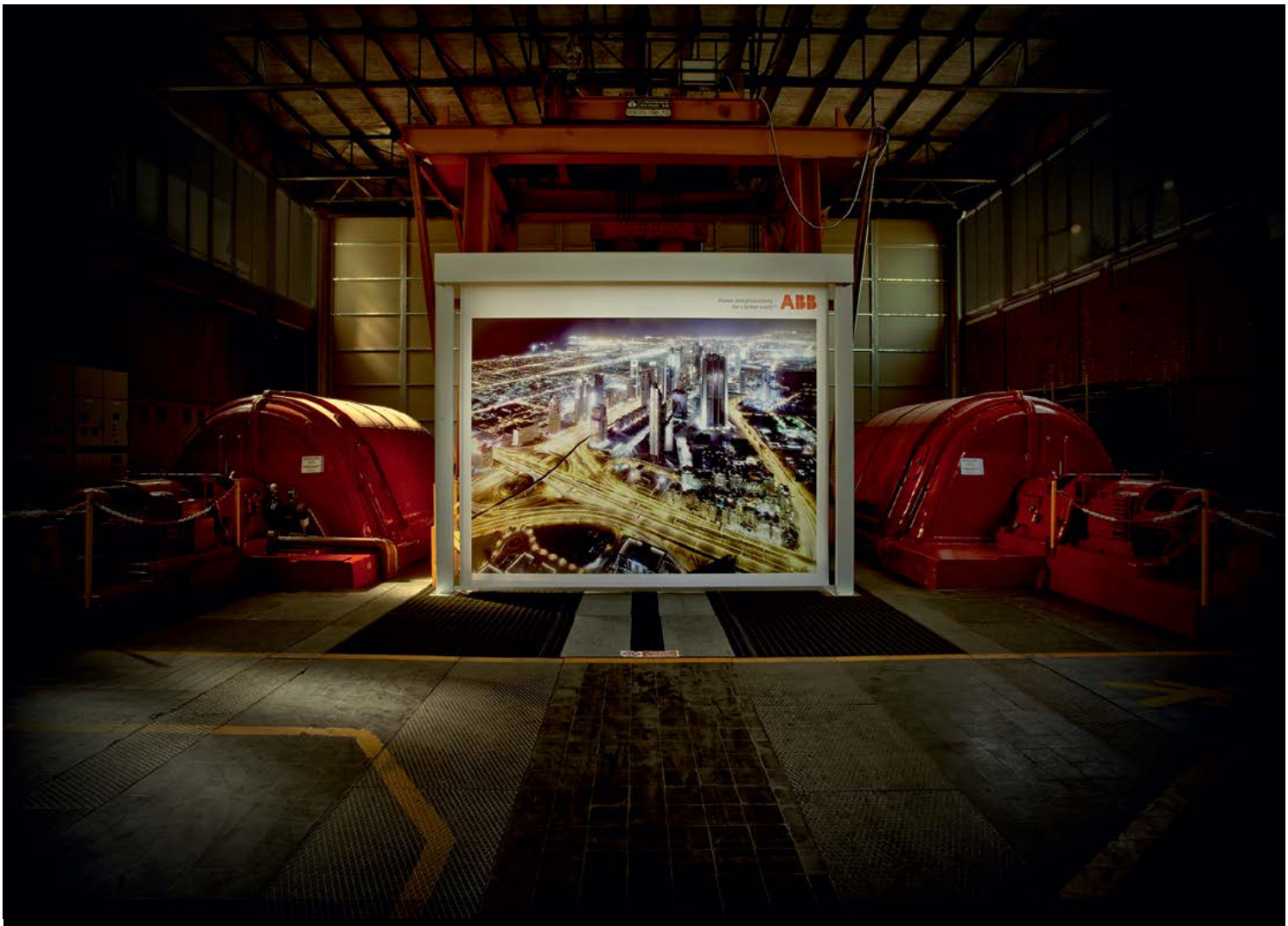
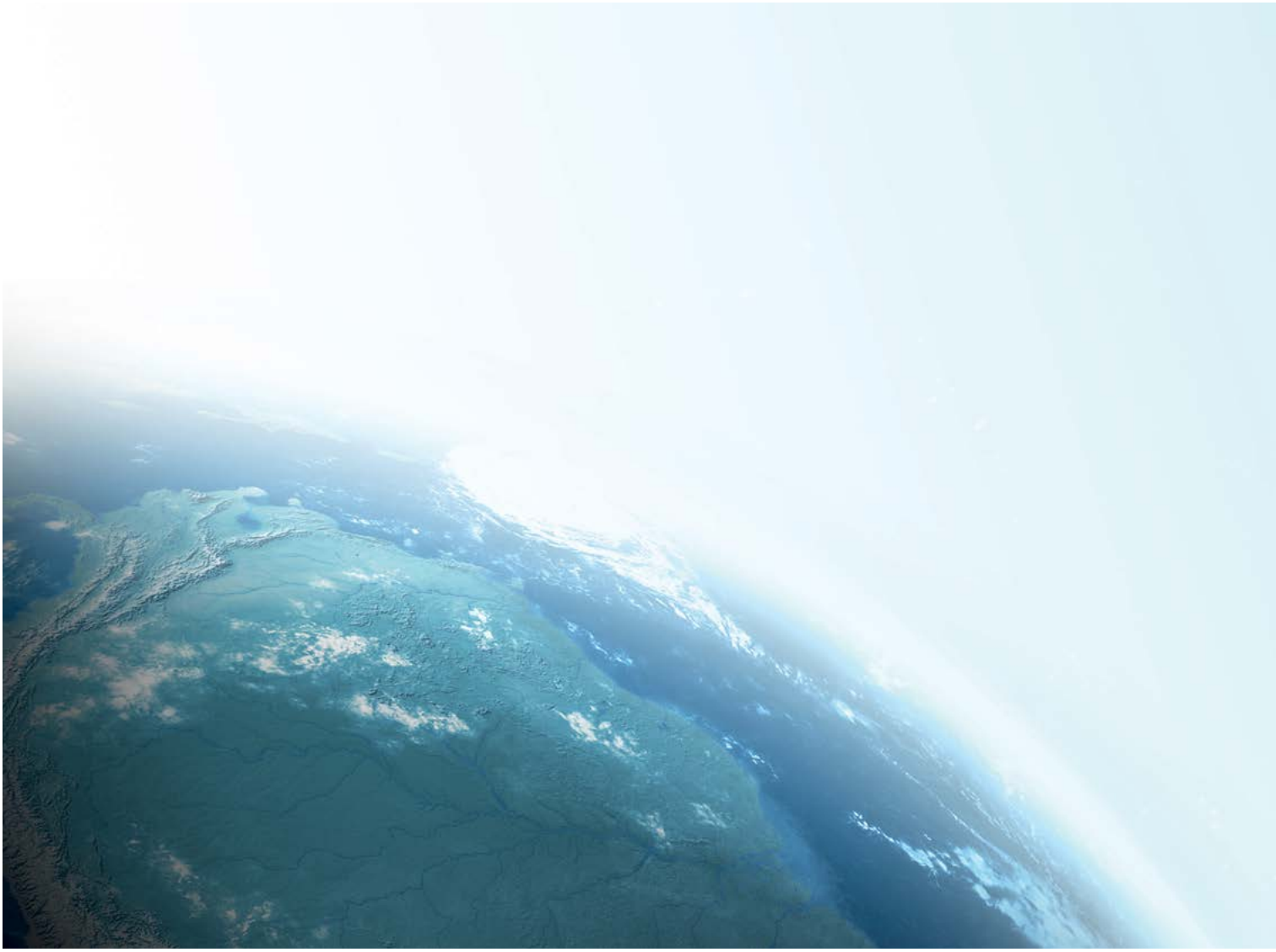


ABB SACE Division
Test laboratory

Power and productivity
for a better world™

World-proof



The ABB S.p.A - ABB SACE Division Laboratory develops, certifies and performs production follow-up tasks for the electrical devices designed and manufactured in different ABB plants. The Laboratory provides a wide range of equipment and experience in electrical, mechanical, climatic and functional tests for low and medium voltage operating, control, safety and measuring equipment. The Laboratory is accredited by ACCREDIA and, thanks to acknowledgements from important international certification bodies such as ACAE/LOVAG, ANCE, ASTA, ETL SEMKO, UL, CSA and Shipping Registers, offers ABB and its customers a qualified certification test service for low and medium voltage electrical devices and equipment, in accordance with the respective product standards.

Our skills

Performing tests and taking measurements correctly is a profession: a group of specialists ensures that the laboratory can provide valid support for its customers thanks to years of experience in many different fields.
Uncommon experimental equipment plus use of advanced measuring and testing techniques allow us to simulate the toughest installation conditions and meet the requirements of domestic and international standards.

The systems

The laboratory covers an area of over 3,500m^2.
The plants are constantly serviced and upgraded thanks to yearly investments, the purpose being to boost their capacity for testing as well as their compliance with the laws in force and the market's more challenging demands.
Thanks to sophisticated techniques, accuracy, and traceability of the measuring methods we can study, investigate and assess the behaviour of the equipment subjected to development and certification tests.

We deal with lightning, fire outbreaks and explosions every day.
The atmosphere at altitudes exceeding 4,000 meters alternates with the depth of mines and temperatures that jump from -40 to over 70 degrees.
We feel the ocean breeze and salty sea air.
Time passes either very fast or very slowly.

Every day, we put our circuit-breakers to the test because they'll be put to test by the world.

The main tests

- **Short-circuit**
  The task of the "Power tests" laboratory is to assess the performance of low and medium voltage apparatus in the presence of high current and voltage values. It is equipped with three alternators, one of which is able to supply up to 2800 MVA.

- **Experimental tests**
  The "Experimental tests" laboratory has equipment for testing mechanical and electrical life, plus duration in overload conditions. It has power suppliers for assessing overtemperature and the characteristics of thermal magnetic and electronic releases in the presence of strong current values.

- **Materials**
  The "Material testing" laboratory researches, analyzes and pinpoints new plastic and metal materials able to comply with the continual need for technological innovation that is now a "must" in the electrotechnical field.

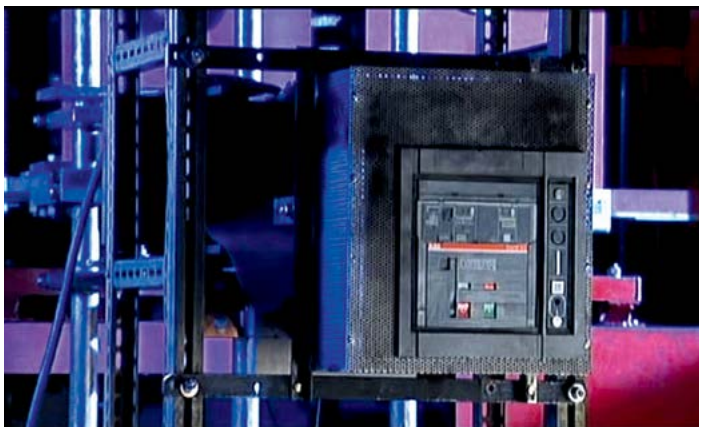
- **Electronic devices**
  The "Electronic test" laboratory assesses the electronic devices in the circuit-breakers and all the accessories that form the circuit-breaker system (dialog, signalling, monitoring devices, etc.).

- **Environmental reliability testing**
  The purpose of environmental tests is to study the behaviour of the apparatus when subjected to accelerated life conditions, such as: corrosive environments, thermal ageing, thermal shock and vibrations or a combination of thermal cycles and vibrations at high level environmental stress levels (HALT).

What happens to your electrical system
when it operates in extreme conditions?
We do everything to find out.
And to limit the consequences.

Short-circuit tests

Short-circuit tests are performed to assess the behaviour of low and medium voltage circuit-breakers and switchgears in extreme operating conditions, such as those resulting from faults caused by lightning or negligent maintenance, or the conditions in electric power stations, industrial installations, chemical plants, off-shore oil rigs or in mines.
The results of these tests enable us to improve the characteristics of the apparatus itself, as well as the safety conditions for both people and the actual installations.
The laboratory equipment also allows us to simulate particular conditions, such as those in installations at high altitudes (with a corresponding drop in atmospheric pressure) or use with wind generators at variable frequencies and direct current photovoltaic systems.



10÷200 kA

The electric current intensity of lightning typically varies from 10 to 200 kiloamperes.

10÷36 kV

The voltage of the line that supplies a neighbourhood is between 10 and 36 kV.

	Kinds of test	Short-time	Making and breaking with AC short-circuit (15-60 Hz)	Making and breaking with DC short-circuit	Overload	Internal arc
DEVICES	**STANDARDS**					
Low voltage circuit-breakers	IEC 60947-2 CEI EN 60947-2	150kA for 1s 90kA for 3s	380V 200kA 600V 200kA 726V 100kA 1100V 80kA	250V 100kA 500V 100kA 1000V 100kA 1500V 30kA	up to 1100V 15kA	–
Low voltage switch-disconnectors	IEC 60947-3 CEI EN 60947-3	150kA for 1s 90kA for 3s	380V 200kA 600V 200kA 726V 100kA 1100V 80kA	250V 100kA 500V 100kA 1000V 100kA 1500V 30kA	up to 1100V 15kA	–
Low voltage contactors and starters	IEC 60947-4-1 CEI EN 60947-4-1	–	380V 200kA 600V 200kA 726V 100kA 1100V 80kA	250V 100kA 500V 100kA 1000V 100kA 1500V 30kA	up to 1100V 15kA	–
Low voltage switchgears and busbar ducts	IEC 61439-1 CEI EN 61439-1 IEC 61439-2 CEI EN 61439-2	150kA for 1s 90kA for 3s	380V 200kA 600V 200kA 726V 100kA 1100V 80kA	250V 100kA 500V 100kA 1000V 100kA 1500V 30kA	–	–
	IEC 61439-6 CEI EN 61439-6					
	IEC 61641 CEI 17-86					up to 726V 100kA for 1s

	Kinds of test	Short-time	Breaks and makes with AC short-circuit (15 - 60Hz)	Overload	Active load current	Internal arc
DEVICES	**STANDARDS**					
High Voltage switchgears	IEC 62271-200 CEI EN 62271-200	150kA for 1s 90kA for 3s	–	–	–	12kV 31.5kA for 1s 24kV 25kA for 1s
High voltage circuit-breakers	IEC 62271-100 CEI EN 62271-100	150kA for 1s 90kA for 3s	12kV 60kA 24kV 32kA 36kV 20kA	–	–	–
High voltage switch-disconnectors	IEC 62271-103 CEI EN 62271-103	150kA for 1s 90kA for 3s	12kV 60kA 24kV 32kA 36kV 20kA	–	24kV 630A 36kV 400A	–
High voltage earthing switches and disconnectors	IEC 62271-102 CEI EN 62271-102	150kA for 1s 90kA for 3s	12kV 60kA 24kV 32kA 36kV 20kA	–	–	–
High voltage contactors (also coordinated with fuses)	IEC 62271-106	150kA for 1s 90kA for 3s	12kV 60kA 24kV 32kA 36kV 20kA	up to 12kV 8kA	–	–

The climate in our laboratory is just right for testing an entire life-cycle at ultra-high temperatures.
Obviously we're talking about electrical apparatus.

Experimental tests

The "Experimental test" laboratory can perform all sorts of tests essential in the development of robust, reliable and precise low voltage electrical devices. Besides the type-tests required by the standards, circuit-breakers, switchgear and contactors must operate correctly in extreme environmental conditions and with high levels of electrical, mechanical and environmental stress.
Due to continuous technological innovation these conditions are more and more frequent.

In order to stress the products beyond their operating conditions and to assess their reliability over the years these kind of tests are performed: mechanical tests in the presence of vibrations and shocks, or with static and dynamic inclination, electrical life and overload tests, extreme thermal cycles in climatic rooms (-40° +100°C, 98% RH) or in corrosive atmospheres.

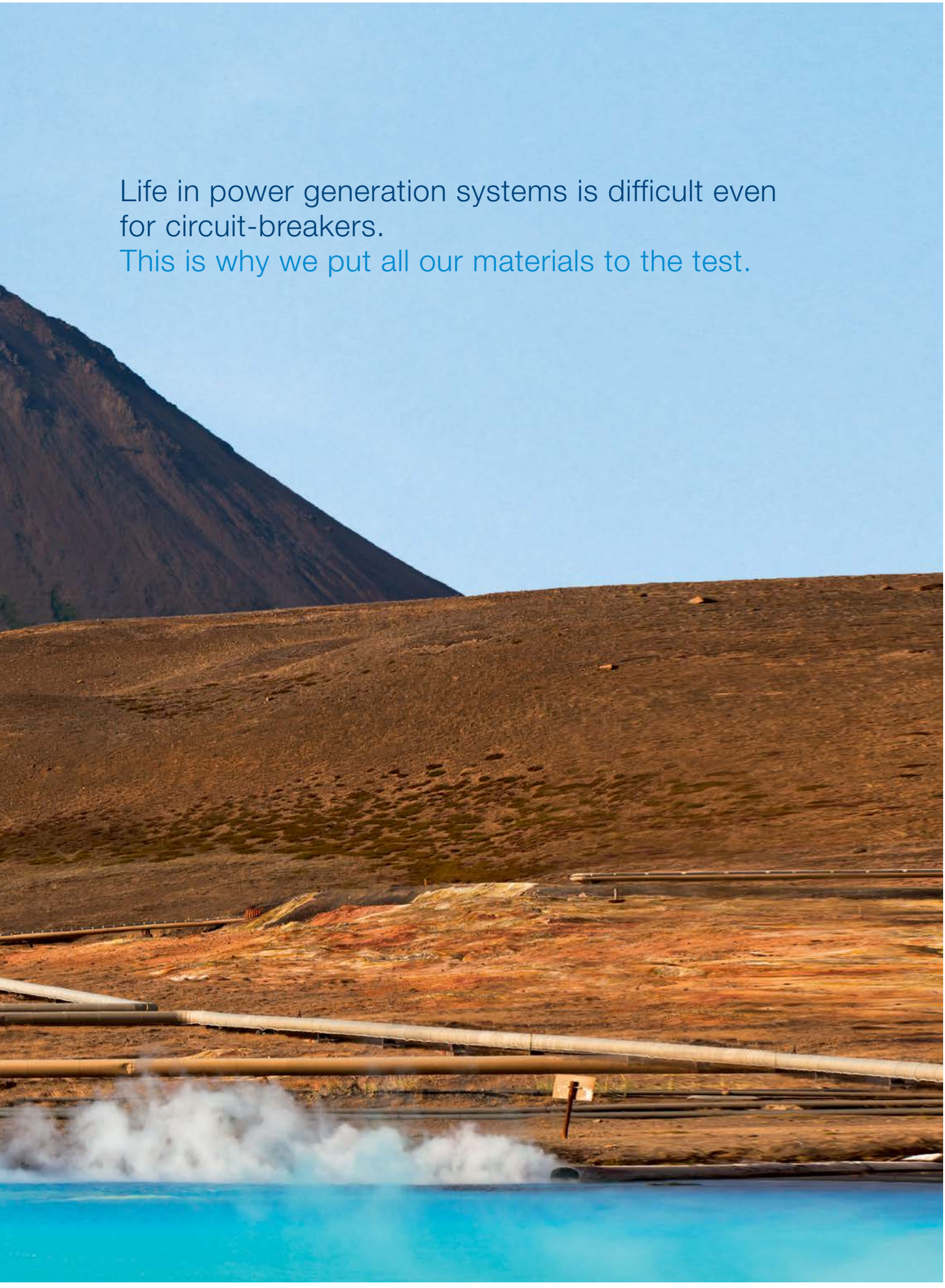
Strong vibrations, polar climates or wide temperature ranges, humidity and corrosive atmospheres can be reproduced with the test technologies used in the "Experimental tests" Laboratory.

6300 A Is the current required to supply 2,510 homes in maximum load conditions.

58 °C Highest temperature recorded on Earth. El Azizia, Libya, September 13, 1922.

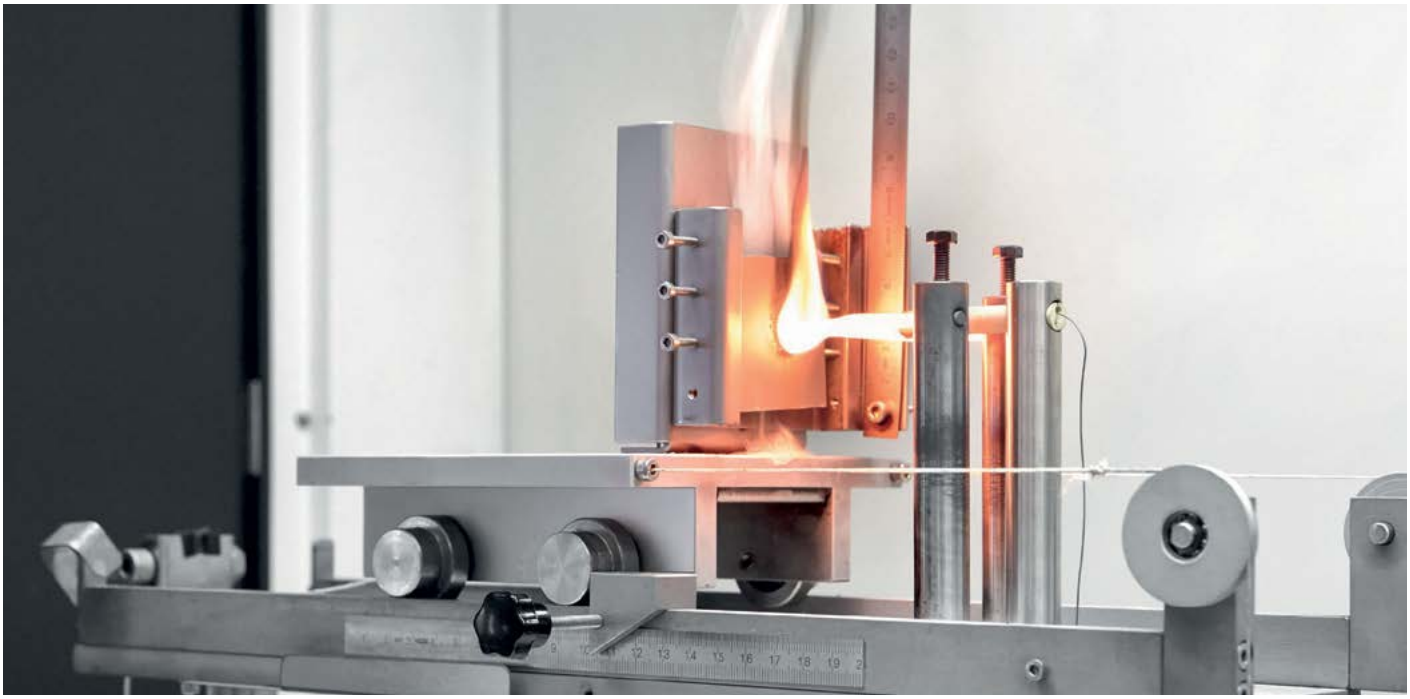
	Kinds of test	Verification of dielectric properties	Verification of temperature-rise	Mechanical, electrical life and in overload conditions	Verification degree of protection	Verification of protection releases (thermal, magnetic, electronic)	Verification of mechanical properties of terminals
DEVICES	**STANDARDS**						
Low voltage circuit-breakers	IEC 60947-2 CEI EN 60947-2	5kV 50Hz 20kV - 1,2/50µs	In=6300A	Vn=1500V In=6300A	IP40	6kA continuous 9kA per 120s 40kA per 0,5s	1,5 mm^2 ÷ 185mm^2
Low voltage switch-disconnectors	IEC 60947-3 CEI EN 60947-3	5kV 50Hz 20kV - 1,2/50µs	In=6300A	Vn=1500V In=6300A	IP40	–	1,5 mm^2 ÷ 185mm^2
Low voltage contactors and starters	IEC 60947-4-1 CEI EN 60947-4-1	5kV 50Hz 20kV - 1,2/50µs	In=6300A	Vn=1500V In=6300A	IP40	6kA continuous 9kA per 120s 40kA per 0,5s	1,5 mm^2 ÷ 185mm^2
Low voltage switchgear and and busbar ducts	IEC 61439-1 CEI EN 61439-1 IEC 61439-2 CEI EN 61439-2 IEC 61439-6 CEI EN 61439-6	5kV 50Hz 20kV - 1,2/50µs	In=6300A	Vn=1500V In=6300A	IP40	–	–

Life in power generation systems is difficult even for circuit-breakers.
This is why we put all our materials to the test.



Material tests

The "Material testing" Laboratory meets the need for information and measurements imposed by the continual technological innovation featured by today's metal and plastic materials industry.
The vast array of tests the laboratory is able to perform include tensile, compressive and flexural strength tests, comparative tracking index tests (CTI), fire resistance and electrical resistance tests and tests to assess the melting and glass-liquid transition temperature of the insulating plastic materials used.
In addition, the laboratory is equipped with a metallurgical microscope, FT-IR and ED-XRF spectrometers, salt mist corrosion test chambers and instruments for assessing the contact plates and their interaction with the electric arc.

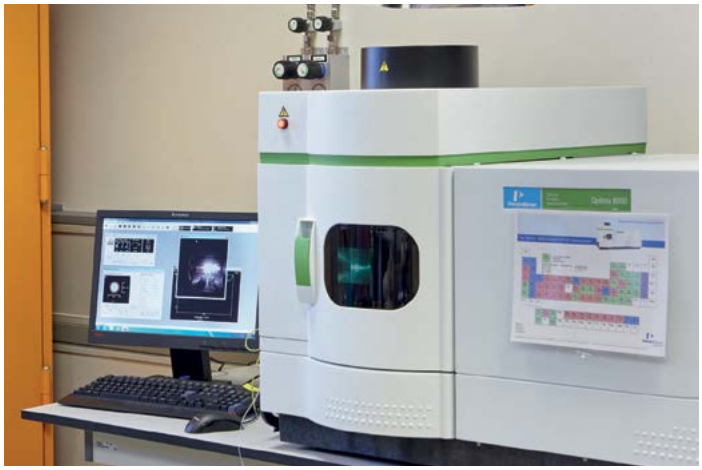


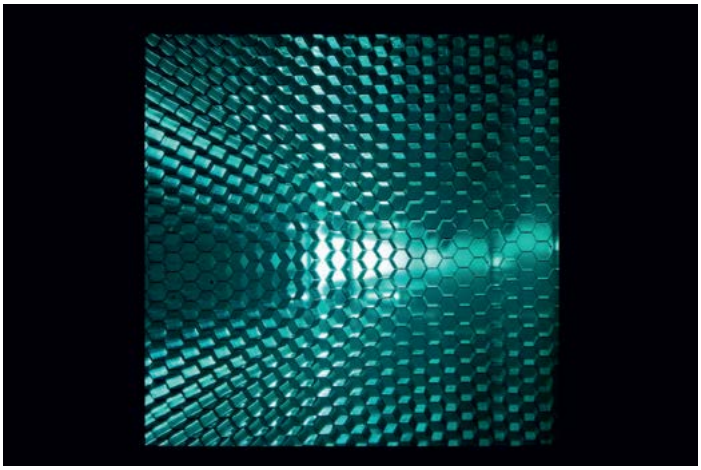
1000 µm/year

Corrosion rate of steel in aggressive environments.

>5 mg/m3

Hydrogen sulphide concentration in environments where geothermal energy is used, 10 times higher than normal values.





	Verifiable characteristics	Reference Standards	Laboratory capacity
Thermal analysis on polymers (with DSC)	Glass-liquid transition temperature	IEC 61006 - CEI EN 61006	temperature range: -65 to +650°C
	Melting temperature and heat	IEC 61074 - CEI EN 61074	measuring range: ±350mW
	Crystallinity	–	–
Mechanical tests	Tensile, flexural, compressive strength	Miscellaneous	load: 0.01 to 50kN speed: 0.001 to 500 mm/min
	Hardness/Microhardness	ISO 6506 ÷ 6508, ISO 4516	HR-HV-HB
Physical tests	Density	ISO 1183	–
	Ash content	ISO 3451	–
	Water absorption	ISO 62	–
	Metal coatings (XRF)	ISO 3497	elements from titanium to uranium
	Infrared analysis (FT-IR)	ASTM E 1421	–
	Viscosity of thermoplastic melts (MFI)	ISO 1133	–
Chemical tests	ICP - OES Elemental analysis of inorganic matter	–	detection limit: µg / kg
Electrical tests	Electrical resistance	–	1*10 -7 Ω<R<1*10 6 Ω
	Comparative Tracking Index (CTI)	IEC 60112 - CEI EN 60112	up to 600V
Combustion tests	Glow wire test	IEC 60695-2-10/13 CEI EN 60695-2-10/13	–
	Flame	UL 94	classification V0 - V1 - V2 - HB
Microscope	With stereomicroscope	–	enlargements: 6x to 100x in reflected and transmitted light microtomic examination
	3D video microscope	–	enlargements: 50x to 400x in reflected light
	With metallurgical microscope	–	enlargements: 25x to 1600x in reflected and transmitted light

Working in complete isolation is sometimes an advantage. Especially if the environment is hostile and the work challenging.

Tests on electronic devices

The "Electronic test" Laboratory can simulate any type of current and voltage to be found in the World, from the direct current
of galvanic systems, solar parks or for powering submarines, to the 1000 Hz ratings of robotized assembly line installations.
We can generate harmonics and disturbance of up to 20 KHz, well over the disturbance that the inverters of wind power installations are able to create.

The electronic section can subject all the electronic components to electromagnetic interference that's way beyond the 5kV Surge value (lightning simulation), the 6kV Burst value (ultra-high power Radio transmitter) and 20kV of electrostatic discharge (ESD).

The electronic section was only created in 2001 but, thanks to continual investments, it has been equipped in little more than 10 years with the best instruments to be found on the market, both as to precision and test automation.
At the present time, this section of the Laboratory can count on ultra-high accuracy (0.1%) voltage and current generators, high resolution recorders, multi-channel calibrators able to simulate any type of load that may occur in an installation, climatic chambers that re-create real conditions of use (from -70°C to 350°C) and water in the circuits, Halt Hass chambers to stress even large components with mechanical and temperature shocks, spectrum analyzers and generators that comply with the most stringent electromagnetic compatibility standards.

6 billion Mobile phones in the world that emit electromagnetic interference.

6 kHz Frequency generated by the inverters in wind power installations.

	Functional tests	Remote control and supervision system functions tests	Functional tests, field bus reliability tests and protocol functionality	Functional tests with special voltage, current and frequences	Electromagnetic compatibility on samples
Tested apparatus	Electronic devices on board circuit-breakers	Electronic devices on board circuit-breakers	Accessory electronic devices (communication, signalling…)	Electronic devices on board circuit-breakers	Electronic devices on board circuit-breakers and accessories
Standards	IEC 60947-2 CEI EN 60947-2	IEC 60947-2 CEI EN 60947-2	IEC 60947-2 CEI EN 60947-2 Product specifications	–	IEC 61000-4-2 IEC 61000-4-4 IEC 61000-4-5 IEC 61000-4-11 IEC 61000-4-29
Range	Precision currents 1mA to 2000A Precision voltages 1V to 2000V	–	–	Programming possible up to the 40th harmonic Current and voltage with 0 to 3000Hz frequency Up to 20 kHz interference currents	Voltage values up to 6kV dip with 1ms step Up to 20kV ESD


The life of an electrical device can be full of pitfalls.
We speed it up to make it longer. And safer.

Environmental reliability tests

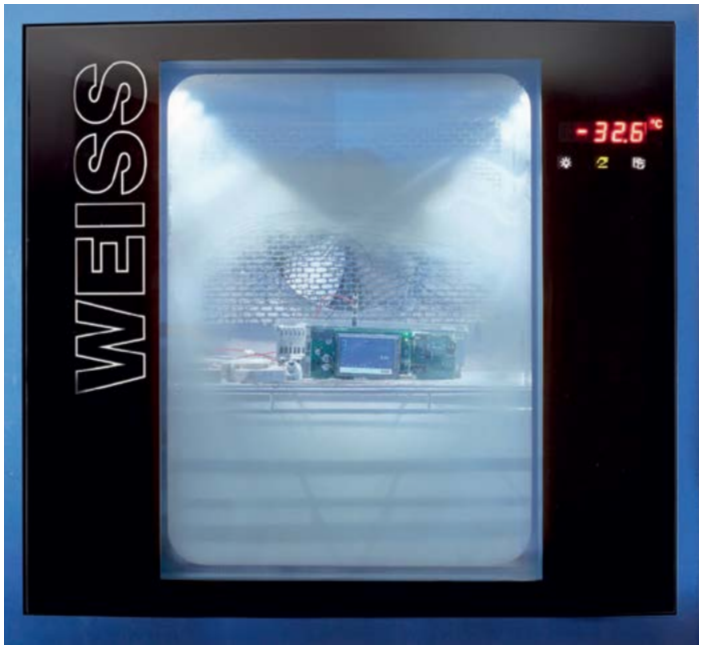
Every day, our circuit-breakers are used in the farthest corners of the World. They are subjected to extreme temperatures and must withstand the heaviest duty mechanical stress.
To make sure they are able to stand up to this rough treatment, we test all the components at Arctic temperatures (-40°C) through to the hottest temperatures of the most scorching desert.

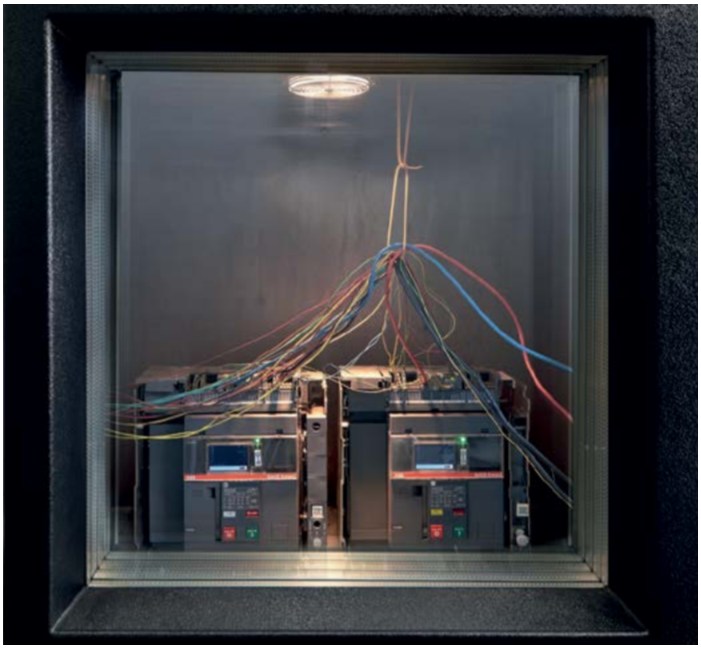
That's not all. To make sure that they are sturdily built, we apply thermal shocks that bring our circuit breakers from -40°C to 150°C with a very high humidity rate (98% RH).

We check the behaviour of the hardware and software of the more critical components during 17°C/minute thermal shocks while applying 30 g vibrations (much more than the acceleration that occurs on a Caterpillar).

-71°C The lowest temperature recorded in Oymyakon, Russia, January 26, 1926.

98% humidity rate and 45°C are the environmental conditions of the Amazon rain forest.





	Corrosion test (Salt mist)	Climatic tests	HALT (High accelerated life testing)	Vibrations	Environmental tests	Mechanical shock test
Description	Corrosion chamber with controlled temperatures and humidity. The test is performed on individual components	Chamber with controlled temperatures and humidity.	Thermal cycles with vibrations	Monoaxial vibrations Random-and sine test with up to 67kN thrusts	Dry heat Damp heat Temperature cycling test Low temperature	Impact resistance test
Standards	ISO 9227 ISO 60068-2-52	IEC 60947-1 CEI EN 60947-1 Shipping Registers [RINA, Lloyd's Register, Bureau Veritas, Germanischer Lloyd, Det Norske Veritas]	–	IEC 60947-1 IEC 60068-2-6 Shipping Registers, [RINA, Lloyd's Register, Bureau Veritas, Germanischer Lloyd, Det Norske Veritas]	IEC 60947-1 IEC 60068-2-2 IEC 60068-2-30 IEC 60068-2-14 IEC 60068-2-1	IEC 61947-1 IEC 60068-2-27
Operating range	Test temperature: t.a. to 55°C Test volume: 600dm3	Temperature: -40 to +180°C Humidity: 10 ÷ 98%	Temperature: -80°C to 180°C (15°C/min) Vibrations: up to 40g rms (power spectral density 0 to 20 kHz	5Hz ÷ 2000 Hz Max acceleration: 95g	da +20 a +70°C da -40 a +180°C e UR 98%	<30g T <20ms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Certifications and acknowledgements

ACCREDIA
(Italian Accreditation System)

ACCREDIA is a non-profit body whose purpose is the accreditation of test laboratories. By means of periodic inspection visits, ACCREDIA accredits the laboratory, for each single test, only after having ascertained the existence of precise technical and organizational requirements, so as to guarantee the metrological references, the reliability and repeatability of implemented procedures, the use of suitable instruments, the personnel's skills, the neutrality of personnel assigned to the tests, according to the provisions of standard UNI CEI EN ISO/IEC 17025 and its prescriptions.
The results contained in the test reports concern exclusively the tested object. The test reports do not entail the product certification.
ACCREDIA is a member of EA (European co-operation for Accreditation) and ILAC (International Laboratory Accreditation Cooperation).
For the list of accredited tests, please visit the website www.accredia.it.

ACAE
(Association for the Certification of Electrical Equipment)

ACAE is an independent product certification body whose members include independent bodies operating in the certification sector, electrical equipment users and manufacturers, research institutions and test laboratories. It is accredited by ACCREDIA for the certification of low and high voltage electric equipment in accordance with standard EN 45011 ("General criteria for product certification bodies") and it is founding member of the LOVAG (Low Voltage Agreement Group) for the mutual acknowledgement of certifications within the EU. It promotes the mutual acknowledgement of certificates of conformity issued by itself and by other Italian, EU and foreign certification bodies.

ETL SEMKO

ETL SEMKO is a world-wide body specialized in product testing, inspection and certification. ETL SEMKO verifies and certifies full compliance of the products to electromagnetic compatibility standards and to performance tests, offering manufacturers a chance to distribute their products throughout the world.

UL

Underwriters Laboratories Inc. (UL) has been a leading independent body since 1894 in safety tests and product certification; UL is the most well-known trademark in the United States, and it has become one of the most widely recognized product conformity suppliers in the world.

ASTA

ASTA was founded in 1938 as the Association of Short-Circuit Authorities. Intertek's ASTA Services team delivers leading services for the electrical industry. Their services include schemes truly recognized internationally approvals for low, medium and high voltage certification. The ASTA marks and/or type test certificates clearly indicate that the product has been independently tested to comply with the relevant clauses of the applicable standards. ASTA Certificates/Reports have International recognition, including a very high profile in Asia and the Middle East, often ‘specified’ by major end-users.

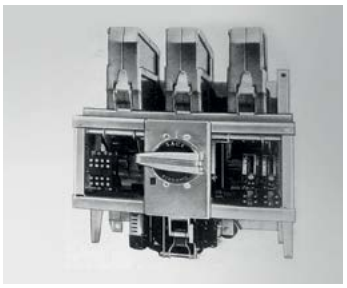
ANCE

The Asociación de Normalización y Certificación A.C. (ANCE) is the Mexican body that comprises all standardization and conformity assessment services. It is the body accredited throughout Mexico for product certification.

CSA

The Canadian Standards Association (CSA) is a not-for-profit organization whose declared mission is to develop standards for use in various different fields of specialization. CSA is formed by representatives from the government, from industry and consumer associations.
CSA began in 1919 at federal level as Canadian Engineering Standards Association (CESA) for the purpose of creating standards. Now, CSA is accredited by the Standards Council of Canada as an organization that develops standards and as a certification body.

Laboratory timeline



1956

since 1956
The laboratory for short-circuit tests was established at the plant in via Baioni and was equipped with:
- a 150 MVA, f = 50 Hz alternator;
- a 60 MVA transformer with 140 V to 34.6 kV secondary voltage values;
- two test cells, used alternatively, with one single data recording system and timer.

Design engineering of new apparatus marked a process of upgrading for low voltage products: the turning point was moulded-case circuit-breaker Z150, tested in the company's outfitted test rooms.

Research into air circuit-breakers was also stepped up and led to the creation of the first Otomax prototype, which replaced the previous series of FRM circuit-breakers.

1970-1976

since 1970
The short-circuit laboratory moved to its present headquarters in via Pescaria and the following machines were purchased:
- two 300 MVA alternators with f = 50 Hz;
- a 200 MVA transformer with 160 V to 1100 V secondary voltage values;
- a 600 MVA transformer with 2 kV to 41.5 kV secondary voltage values;
- two test cells, used alternatively, with one single data recording system and a synchronizable timer.

The Material Test Room was also created as a Quality Control Laboratory and was used to perform the following tests:
- metallography tests plus analysis of the hardness and density of the electrical contacts and metal components:
- tensile and compressive strength tests up to 50 kN;
- fire resistance tests on plastic materials;
- ball pressure tests.

since 1976
The Experimental Tests section acquired a Brentford generator for continuative tests up to 6 kA and overload tests up to 40 kA.

since 1976
The first version of the digital recording system for test results became a reality and the first high speed video footage was taken.

The Experimental Tests section purchased test benches for performing relay tripping and heating tests on the entire range of direct and alternating current circuit-breakers.

1990-2001

since 1990
A new 2800 MVA alternator increased the power available for the short-circuit tests. The following equipment was also purchased:
- a 200 MVA transformer with 160 V to 1100 V secondary voltage values;
- two 900 MVA transformers with 2 kV to 41.5 kV secondary voltage values;

The Material Test Room began to support the project engineering tasks for low voltage circuit-breakers. New measuring instruments enabled both plastic and metal components to be subjected to a new range of tests. These tests included:
- infrared spectroscopy (FT-IR)
- differential thermal analyses (DSC);
- glow wire resistance tests.

since 1996
Digital equipment took over from the analog recording systems. The direct current short-circuit values were also increased thanks to a new rectifier bridge.

since 2000
A second station for low voltage tests was installed, with current values of up to 70 kA and voltage values between 140 V and 1000 V.

since 2001
A new laboratory section dedicated to Electronic devices was created.

2005 -2013

since 2005
All the laboratory sections were unified in the present building in via Pescaria.

since 2006
The laboratory dedicated to electromagnetic compatibility (EMC) was created for the purpose of pre-compliance tests.

since 2007
The Laboratory began to perform the first Halt/Hass tests with -70 °C to 200 °C stress capacities at 30 g acceleration. Additions were made to the Experimental Tests section with single-phase and three-phase static feeders for tests with 16 Hz to 400 Hz frequency values and current values of up to 10 kA in continuous duty and 18 kA in overload conditions.

since 2009
A new shaker allows vibration and impact tests to be performed.

since 2012
The new ICP-OES equipment (atomic emission spectroscopy) was purchased for the chemical analysis section of the Material Test Room, thereby allowing the elements in different types of materials to be analyzed.

since 2013
The low voltage performance of the short-circuit laboratory was increased to a further extent: up to 440 kA peaks, 150 kA for 1 second and 15 Hz to 60 Hz variable frequency tests. The electric life system was boosted for direct current tests of up to 2000 A with up to 2000 V voltage values.

Contacts

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