Switchgear technology from Berlin for the world
Welcome to Schaltwerk Berlin
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Preface

Berlin has a long tradition of being a site of modern industry. It was at one time the cradle of Germany’s economic ascension, fueled by big names such as AEG and Borsig. One big name that remains to this day is Siemens.

More than 160 years have passed since Werner von Siemens and Johann Georg Halske first founded their “Telegraphenbauanstalt” in Berlin. So began a unique success story, in which Siemens would become a global company. Even when its headquarters were transferred to Munich after the Second World War, the company maintained its strong commitment to Berlin. Today, Siemens is still one of the city’s economic pillars and Berlin’s largest industrial employer.

The history and development of Siemens Schaltwerk Berlin impressively demonstrate the close bond between city and company. Conceived around a hundred years ago, it is now the world’s largest switchgear manufacturing plant. Thanks to state-of-the-art production engineering, highly qualified and committed employees, and a great deal of innovative strength and expertise in research and development, switchgear technology that is “made in Berlin” has gained worldwide recognition. The plant has also proven that the German capital is an excellent location for innovative industrial companies that know how to tap into the city’s creative and scientific potential.

In this spirit, I congratulate the Siemens Schaltwerk Berlin for its approximately one hundred years of innovation and tradition at the Berlin site, and offer my heartfelt wishes for its continued success in the future.

Klaus Wowereit
Governor Mayor of Berlin
Building the future

Innovative power as a tradition

In all parts of the world and on every voltage level, switchgear systems from Berlin guarantee a maximum of safety in power networks. Schaltwerk Berlin, the largest production facility of its kind in the world, has a long tradition of being the birthplace of future-oriented switchgear technology, where products and systems are created that help maintain the cost-effective and reliable transmission and distribution of electrical energy, both now and in the future.

About 100 years of development experience as well as state-of-the-art laboratories and testing stations on-site ensure that Siemens switchgear systems will continue to set new industry-wide standards in terms of efficiency, cost-effectiveness, and reliability. With one of the world's largest private test laboratories for testing switching capacity – also accredited to perform internationally recognized type tests to ISO/IEC 17025 – and with a team of over 300 top-ranking specialists in the fields of science and technology, Schaltwerk commands unique research and development resources. This has made it the company-wide Competence Center for all Siemens production facilities in the switchgear systems sector. Around 50 new patents per year serve to emphasize the plant's superior position in the development of future-oriented technologies, also on the international level.

Combined development and manufacturing expertise within Schaltwerk, highly qualified and committed employees, a depth of production that is far above average, and continuing investments in production plants – these factors guarantee that all products and systems manufactured at Schaltwerk will always meet the highest quality standards. At the same time, the pioneering range of products produced at the plant meet all market requirements for innovative and reliable products that are also economical. That's why switchgear systems from Berlin are known throughout the world and are in such high demand. Every year, more than 4,000 visitors from all corners of the globe come to Berlin to experience this unique plant at first hand. Welcome to Schaltwerk Berlin!
The complex processes involved in interrupting electric current require maximum precision. A high-voltage circuit breaker, for example, must be able to effortlessly manage a million times the power of a normal domestic fuse. When such enormous amounts of energy are in play, accuracy on the order of millionths of a second is required to ensure that electric power is disconnected safely with no damage to equipment, and also to prevent any consequential damage to the supply system or at the consumer level. At the same time, the market demands ever-greater switching capacity in increasingly small spaces. What’s more, switchgear today has to operate safely and reliably under the very harshest environmental conditions: in permafrost regions, at extreme altitudes, or on the high seas.

Intensive research and development
All of these challenges are no problem for the technology developed at Schaltwerk Berlin. Here, in close collaboration with the customers, targeted solutions are devised for a wide range of different requirements. All the resources necessary for the development of increasingly efficient and economical switchgear generations and pioneering technologies are concentrated at this factory.

Accreditation
The test bays of Schaltwerk Berlin are accredited according to ISO/IEC 17025. Siemens thus complies with an essential precondition to receiving product certificates accepted worldwide. The accreditation comprises tests of high- and medium-voltage switchgear as well as equipment and components of electric energy technology according to relevant test instructions.
All development work is based on the physical calculations that accompany the testing of switching capacity and dielectric strength. In this respect, Schaltwerk Berlin has a distinct advantage in that it is not dependent on external test laboratories, which gives it a valuable time lead. A succession of milestones has marked the history of Schaltwerk over the decades, for example the introduction of vacuum switch technology in 1976, or of the world’s first low-voltage vacuum circuit breaker in 1992.

Innovations to protect your investment
A particularly successful recent development in the high-voltage sector is the so-called dead tank compact circuit breaker (DTC) for rated voltages of 145 and 245 kV. These compact switching modules offer all the functions of a complete switchgear with minimal space requirements. Circuit breakers, disconnectors, and grounding switches as well as current and voltage transformers are integrated in an extremely compact space. Thanks to their space-saving design and high cost-effectiveness, DTCs provide a groundbreaking alternative to classic types of switchgear, especially for the connection of distributed renewable energy sources. The modular concept also makes it possible to cut installation and commissioning times to a minimum.

The gas-insulated high-voltage switchgear (GIS) with sulfur hexafluoride (SF₆) as an insulating and arc-extinguishing medium was also developed at Schaltwerk Berlin. This concept – which was revolutionary when it was first introduced in 1968 and remains unsurpassed to this day – boasts outstanding durability, excellent cost-efficiency, and a high degree of reliability. Modern gas-insulated switchgear provides answers to the demands of a society increasingly hungry for electricity. The innovative design of the current switchgear combines further improved performance, reduced footprint, and minimized materials and SF₆ usage. The 8DN8 type GIS for 72.5 to 170 kV are setting new standards in terms of bay layout flexibility. The compact 8DQ1 series 420 kV GIS impresses with its capacity: it can switch an 80 kV short-circuit current.

Medium-voltage switchgear for all potential application areas
The same strict specifications applicable for high-voltage switchgear also apply at medium-voltage level. The systems manufactured by Schaltwerk Berlin represent optimum availability and maximum operating reliability. The core element of these systems is the vacuum circuit breaker produced here in Berlin.

Individually tested on systems developed at the factory itself, and extremely compact in design, these circuit breakers offer maximum reliability and performance while taking up very little space. They operate absolutely reliably even under the most extreme conditions, and fulfill all environmental requirements to an exemplary degree.
Expanded capacities
Cast resin components are an integral part of gas-insulated switchgear. A particularly important type, for example, is the so-called triple bushing, a gastight bushing shared by three mutually insulated phases that must be able to withstand the high internal pressure of the SF₆ insulating gas that is used. These components are also produced at Schaltwerk Berlin. More than 1,000 metric tons of different resin mixtures are used here each year to produce insulation components that meet the highest standards.

The logistics center with an area of 7,500 m² provides a number of central services from goods acceptance all the way to recycling. A turnover of more than 3,000 articles a day is managed here, with the goal of achieving a delivery punctuality and accuracy rate of 95 percent. Many products are shipped completely assembled. Assembled and tested double bays of the gas-insulated 8DN8 switchgear for 145 kV, for instance, can be shipped in standard containers with up to six bays. This saves time and costs for installation and commissioning.
One hundred percent reliability is an absolute must for switchgear at all voltage levels: this is dependent upon maximum quality throughout the manufacturing process, from the raw materials to production. For this reason, Schaltwerk Berlin relies on the latest production technologies, in which it invests systematically and effectively. The high depth of production at the factory and optimized processes – in which quality assurance and final inspection are integral elements – ensure consistent top quality.

Outstanding quality, shortest delivery times
Every employee at Schaltwerk is dedicated to the goal of achieving maximum quality and reliability. For this reason, every detail of the production process is elaborated and organized directly within the production teams. This results in transparent, ergonomic, clean, and time-saving processes as well as perfect quality of the end products.

State-of-the-art CNC technology is employed at Schaltwerk for sheet-metal processing as well as in the production of containers and drive units. And the networking of all data systems, from design to production, ensures consistent compliance with all defined quality parameters, thanks to perfectly integrated processes despite extremely short throughput times. Precise timing of all work stages and quality inspections integrated seamlessly into the technological processes entail the fastest possible delivery of made-to-order products that meet the customer’s specific requirements.

Production processes optimized in every respect

The combined blanking-laser technology ensures maximum flexibility in parts production and minimum throughput time

Clean-room conditions and continuous monitoring of all process parameters guarantee consistently high quality

The mixing and measuring system impregnates the insulated boards and pipes – parts that are needed for the production of substations and switchgear

Siemens is fully committed to the preservation of the natural bases of life

Galvanic finishing of components: the automatic galvanic plant uses water from a closed circuit for the various process steps
Responsibility at all production stages

Consistent environmental compatibility

Protection of the environment has been firmly established as a corporate goal at Siemens for years, and is systematically implemented at Schaltwerk Berlin. One hundred percent environmentally compatible activities over the entire life cycle of a product pay off, not only for the environment but also for customers and for the company. The best proof of this commitment to the environment at Schaltwerk is the certificate for ISO 14001-compliant environmental management, awarded for the first time in 1994.

Environmental protection plays a crucial role even in the development stage, from the selection of environmentally benign raw materials wherever possible and highly resource-saving handling of all working media and materials, up to the systematic avoidance of waste and comprehensive recycling. Modern CNC sheet-metal cutting systems, for example, enable optimum use of the material. All plastics are processed exclusively using single types, in order to facilitate recycling and to enable them to be disposed of harmlessly. Water in the closed coolant circuit is treated continuously to avoid wastewater. The electroplating shop is specially designed to reduce environmental impact and save resources. The process water is constantly fed back and cleaned in order to prevent polluted wastewater, and metals such as copper, zinc, nickel, and silver are used with virtually no loss at all. Environment-friendly degreasing agents and water-based paints at Schaltwerk is a given.

Elaborate and closely intermeshed production stages, from the starting material to the finished product, minimize the distances traversed in the manufacturing process. That not only saves time but also energy for transport. Medium-voltage circuit breakers, low-voltage circuit breakers, and surge arresters, for example, are completely assembled in one hall and even packed there, ready for shipment. The use of reusable or recyclable packaging such as containers and Euro-standard crates, and also taking back empty packaging, saves the environment and also saves on disposal costs for customers.

And when it’s time to take back a product at the end of its service life, Schaltwerk Berlin provides exemplary service. A large proportion of the reusable materials are fed back into the materials stream, and used SF₆ insulating gas is recovered by expert specialists.

The SF₆ used in gas-insulated switchgear is a potent greenhouse gas. For this reason, emissions must be avoided during production of gas-insulated systems as well as during their operation and maintenance. In accordance with a voluntary commitment declaration by German industry, comprehensive monitoring of the whereabouts of SF₆ gas has been practiced at Schaltwerk Berlin since 2000. In close collaboration with leading foundries in Europe, Siemens has developed special techniques for the production of diffusion-proof cast aluminum housings. Siemens has achieved an annual SF₆ leakage rate of less than 0.1 percent. This is considerably better than stipulated by international standards and regulations, and represents an important contribution to environmental protection.

Furthermore, since July 2009 a pan-European ordinance stipulates that only certified personnel with proof of their expertise are allowed to handle the gas. Once again, Schaltwerk Berlin sets the standard. Its in-house training center was accredited in March 2009 as an independent examination and certification institute for this certificate of expertise.
Economical, safe, and enormously durable: gas-insulated switchgear (GIS) up to 800 kV

Highly integrated switchgear (HIS) up to 550 kV saves a great deal of space

Optimum and space-saving solution: dead tank compact (DTC) up to 245 kV

Gas-insulated lines (GIL) are a technically attractive, low-cost alternative to cables and overhead lines

High-voltage circuit breakers from Siemens offer the technically and economically optimum solution for every requirement
Comprehensive portfolio for all voltage levels

The product range at Schaltwerk Berlin

Switchgear technology from Berlin is in service throughout the world. Individualized solutions from Schaltwerk Berlin at all voltage levels and throughout the entire power transmission and distribution process ensure flexibility, reliability, and cost efficiency in power plants, transformer substations, and secondary distribution networks, as well as in industry, transportation systems, and building technology.

High voltage
The majority of the products and systems manufactured at Schaltwerk Berlin can be assigned to the high-voltage range:
- Gas-insulated switchgear (GIS) from 72.5 to 800 kV
- Highly integrated switchgear (HIS) up to 550 kV
- Dead tank compact (DTC) up to 245 kV
- Gas-insulated lines (GIL)
- Circuit breakers, disconnectors, grounding switches

Medium voltage
Vacuum switching technology is the focus of medium-voltage development activities at Schaltwerk Berlin. Vacuum interrupters are produced here, as are circuit breakers and contactors based on the same switching principle.
- Compact vacuum interrupters for 1 to 40.5 kV
- Vacuum reclosers for outdoor applications up to 38 kV
- Vacuum circuit breakers for medium-voltage switchgear and for retrofit solutions
- Vacuum contactors for the reliable switching of AC loads in indoor systems
- Vacuum circuit breakers up to 6,300 A and 40.5 kV for switching particularly high power

Surge arresters
For the entire voltage range from high to low voltage.

Vacuum reclosers protect medium-voltage overhead power transmission lines from outages due to temporary faults
Vacuum circuit breakers for universal installation in common medium-voltage systems
Vacuum contactors for frequent switching – also as compact contactor-fuse combination
Surge arresters protect motors, generators, and transformers from overvoltages
State-of-the-art knowledge

Comprehensive offering of initial and advanced training

As the world of energy transmission and distribution grows more and more complex, operating personnel are required to have maximum technical expertise. That’s why the Training Center at Schaltwerk offers a number of practice-based initial and advanced training programs. Courses cover the basics of cost-effectiveness as well as the planning of maintenance jobs and the correct responses to faults – always as reality-based as possible, in small groups, and tailored to the customers’ specific interests and requirements. Theory and practice go hand in hand with plant visits and intensive training on operational, original equipment.

The training program’s modular structure means that individual courses can be combined at will, making it possible to offer precisely the information and expertise that are essential to the customer’s practices on-site – directly from the manufacturer, taught by qualified experts and practitioners who work according to the latest methods. Languages of instruction are German and English. The Training Center is even excellently equipped to meet any special dietary needs the trainees might have.

Moreover, the Information Center takes care of the about 4,000 visitors Schaltwerk Berlin receives every year. Tours of the factory provide information about the production site, the products made, the production processes, and quality assurance measures.

The Information Center in Schaltwerk’s office building is the first point of contact for all guests

Hands-on switchgear technology: practical application is the number-one focus of the training

Training in small groups ensures a successful learning outcome
Dedicated employees

The secret of success: everyone pulling in the same direction

For over 160 years, Siemens and Berlin have been inseparable. The company was launched in Berlin in 1847 with ten employees. Today, Siemens employs some 13,000 people in Berlin alone. These employees are the key to the plant’s innovative power and its strong position on the international market as well. Visitors to the plant immediately notice the amount of pride employees have in their plant and in their personal contribution to its overall success – and for good reason: the degree of employee involvement in the optimization of processes is astonishing to outsiders, from designing the most ergonomic workstations, to efficiently organizing the material flow within the manufacturing process, all the way to developing highly flexible working hours schemes.

Employees are also extremely involved in the company suggestion system, and over 80 percent of the ideas submitted are implemented. These suggestions deal with workplace improvements as well as technical modifications of products, logistical improvements, supplier management, and even process improvements for customers. Consequently, they serve to promote productivity while making a decisive contribution to the plant’s innovative power.

To ensure Schaltwerk’s future over the long term, a great deal of importance is given to encouraging qualified and motivated junior employees. The plant’s office building brings together the central components of Siemens’ professional training in Berlin under one roof, including the Siemens Technical Academy and the technical vocation training center, plus a comprehensive advanced training program that is also open to other companies. The initial training program covers both technical and commercial professions. Committed instructors, ample facilities, and the latest equipment all guarantee fast, efficient, and practical learning. Each year, Schaltwerk trains around 120 young people to meet today’s requirements as well as the requirements of the future.

Innovative training concepts prepare our trainees for the current requirements of their profession

During the production process, qualified, committed professionals take responsibility for the high standard of quality applied to the products

Teamwork among our employees is evident through every phase of the development and production processes
A tradition of top performance

Siemens’ building activities on the Nonnenwiesen in Berlin date back over 100 years. Beginning in 1899, Siemensstadt – a formidable “electro-metropolis” with huge factory installations, extensive residential buildings, and numerous urban and communal facilities – was developed step by step between the Hohenzollern Canal to the north, Charlottenburg-Nord to the east, the River Spree to the south, and Haselhorst to the west. In the 1920s, the foundation stone for Schaltwerk Berlin was laid in the vicinity of the then-new Berlin headquarters of Siemens. The Hochhaus (high-rise) complex of the switchgear factory, with its clean, harmonious lines, was soon considered the most modern factory in Europe. The factory, whose buildings have been listed as a historical monument since 1994, can look back on an eventful and inspiring history of outstanding technical performance spanning nearly 100 years.

**Historic milestones**

<table>
<thead>
<tr>
<th>Year</th>
<th>Event</th>
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<tbody>
<tr>
<td>1916–1918</td>
<td>Construction of the low buildings to designs by Hans C. Hertlein</td>
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<td>1916–1919</td>
<td>Construction of Schaltwerk as the production facility for low- and high-voltage switching systems</td>
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<td>1916–1919</td>
<td>Temporary assembly of aircraft components and engines in the factory halls</td>
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<td>1922</td>
<td>Beginning of oil circuit breaker production</td>
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<td>1926–1928</td>
<td>Construction of the Hochhaus as the production building to designs by Hans C. Hertlein and Carl Köttgen</td>
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<td>1930</td>
<td>Development of the world’s first expansion circuit breaker</td>
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<td>1944</td>
<td>Partial destruction of the factory in air raids</td>
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<td>1958</td>
<td>Beginning of construction of the high-voltage testing laboratory</td>
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<td>1964</td>
<td>Development of Europe’s first SF₆ high-voltage circuit breaker</td>
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<td>1968</td>
<td>First gas-insulated 110 kV high-voltage switchgear goes into operation in Berlin</td>
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<td>1973</td>
<td>Presentation of the revolutionary self-extinguishing principle for high-voltage circuit breakers</td>
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<td>1976</td>
<td>First German medium-voltage system based on vacuum switching technology</td>
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<tr>
<td>1992/1993</td>
<td>Development of the first stored-energy spring mechanism for high-voltage circuit breakers at Siemens; presentation of the world’s first completely maintenance-free vacuum circuit breaker</td>
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<tr>
<td>1995</td>
<td>Development of the first SF₆ circuit breaker with self-compression arcing chamber</td>
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<tr>
<td>1996</td>
<td>Construction of the medium-voltage testing laboratory</td>
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<tr>
<td>2001</td>
<td>Schaltwerk Berlin receives “Factory of the year” award from “Wirtschaftswoche” business magazine and INSEAD</td>
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<td>2010</td>
<td>Onset of the investment program “Schaltwerk 2015” to improve the competitiveness of the production site</td>
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1918: Assembly of aircraft in the low buildings  
1959: Construction of the parabolic hall with copper roof to shield against electromagnetic interference  
2004: Ultramodern CNC production systems ensure maximum precision in container production
A strong hub in a global network

Schaltwerk Berlin as a partner in the international Siemens production network

The use of innovative technologies and deployment of a highly qualified workforce ensure that the products and solutions from Schaltwerk Berlin meet the high expectations of international customers.

Customers’ requirements and preferences can be specifically determined in coordination with Sales & Marketing, which makes full use of the market proximity at its disposal through its dense global network of regional representatives.

Innovative products are created in joint projects through cooperation with plants at other company locations: this brings expertise on a global scale into the development process.

In this way, competitive products and systems can be produced in a network of international production facilities, providing our customers maximum benefits in the field of power transmission and distribution by utilizing synergies for creating added value, sourcing, and improving quality.

There are direct partner factories of Schaltwerk Berlin in:
- Voronez (Russia)
- Aurangabad, Hyderabad, and Mumbai (India)
- Hangzhou, Shanghai, and Wuxi (China)
- Cairo (Egypt)
- Johannesburg (South Africa)
- Querétaro (Mexico)
- Jundiaí (Brazil)
- Jackson (USA).