By 1911, BBC had developed an electrically powered locomotive that ushered in a new era of railway electrification. In 1883, ASEA was founded in Västerås, Sweden, by Ludvig Fredholm. ASEA's very first products – for electric light and generators – very much contributed to a better world. Similarly, when, in 1891, Charles Brown and Walter Boveri created Brown Boveri & Cie. in Baden, Switzerland, their electrical products facilitated major improvements in the lives of many millions. Indeed, by making the widespread use of a brand-new resource – electricity – possible, the products developed by these two progenitors of ABB made a major contribution to the greatest technological change society had ever seen.

In 1897, there came the first of many high-voltage oil circuit breakers; and by 1911, the company had developed an electrically powered locomotive that ushered in a new era of railway electrification. In fact, locomotives formed a significant part of BBC's research and development effort right up until the end of the 19th century.

In 1905, BBC suggested to the SBB (the Swiss national rail operator) that the Simplon Tunnel, then under construction, should be electrified. The SBB declined and BBC offered to do the job at its own cost. Although not a financial success, the project resulted in the world’s first international electrified train link and the experience gained gave BBC’s railway electrification business a massive boost, as was evident by the many contracts won in the subsequent years, including the huge order for the Gotthard Tunnel some 15 years later.

ABB celebrates 125 years’ existence in Switzerland and 100 years of corporate research
Between the wars
The period 1918–1939 proved to be stormy. After a worker and raw material shortage during World War One, BBC experienced a short boom up until 1920, when there was nearly a complete collapse in orders for some years. The subsequent recovery was short lived as the Wall Street Crash of 1929 wreaked further havoc. Once again, however, the business bounced back and in 1939 the first shareholder dividends for seven years were paid out.

BBC – war and expansion 1939 to 1970
In 1936, BBC had become a late entrant to the radio market but succeeded in quickly establishing itself, with its first transmitter valve appearing in 1939. Valve production was moved from the laboratory to a specially constructed factory in 1943. Valve technology gradually expanded from purely radio transmission to heat generation for industrial applications and radiotherapy. This was to culminate in the development of a clinical electron accelerator (Betatron) by the end of the decade.

In 1939, BBC built the world’s first gas turbine, which served the town of Neuenburg as an emergency generator until as recently as 2002. It now adorns the pavilion of the ALSTOM works in Birr, Switzerland as a proud reminder of BBC’s history.

The outbreak of World War Two threw the company into renewed turmoil. Once again, there was a shortage of workers due to military conscription, even as orders grew. The company found itself in a delicate situation, supplying both the allies and the Third Reich. However, home orders rose to record levels (40 percent of all orders were delivered to Swiss customers in 1942/43) – especially in power generation products. Moreover, Spain, rebuilding after the civil war, became one of BBC’s largest customers.

In the midst of World War Two, the company managed to find the resources and time to build the high-voltage laboratory in Baden – a facility that was to prove invaluable in years to come.

By 1935, BBC in Mannheim, Germany, had grown to dominate the original site in Baden. Business flourished with orders for war material: U-boat drives, warship turbines, jet engine compressors, etc., but heavy bomb damage in 1944 subdued activity, though the company was flourishing again within ten years’ of war’s end.

Toward the end of World War Two, orders exceeded capacity and when the war ended in 1945, the company found itself in a favorable business position as most divisions expanded. The mid-1950s saw a boom in steam turbines, with systems of unprecedented power and massive orders from customers such as the Tennessee Valley Authority (who were to receive a record-beating 1,300 MW BBC turbogenerator in 1967). Turbochargers saw similar growth – both in business volume and technical capability.

In 1953, BBC’s specialized laboratory for aerodynamics and combustion research was opened. 1965 saw BBC bring out the world’s first water-cooled hydro-
Like the BBC story above, ASEA also has a history studded with technical breakthroughs. In this, the 100th anniversary of the founding of the ASEA’s corporate research arm, it is worthwhile to look back at some of the momentous products that the organization has produced in the past decade or so.

### Driving progress

By the late 1960s, the pace and breadth of both ASEA and BBC’s technological progress had increased significantly and advances in electronics were opening up entirely new ways to approach industrial problems. An early example of the benefits delivered by electronics was the digital variable-speed drive (VSD).

Electric motors are ubiquitous in industry. In fact, about two-thirds of all the electrical energy produced in the world is converted into mechanical energy by electric motors. The vast majority of these motors are used to power fans, pumps and compressors. Most of these applications operate at constant speed, all the time, even when not needed, using throttles or valves to control the flow of fluids or gases. This represents a huge waste of energy.

Enter the VSD. Launched in 1969, and equipped with a revolutionary technology called direct torque control (DTC), VSDs adapt the speed and torque of the motor according to the precise needs of the application. Typically, energy savings of around 50 percent can be achieved and control quality improves.

In 2011, ABB made another significant step in motor technology with its synchronous reluctance motor (SynRM).

### SynRM

Induction motors (IMs) are by far the most common motors in industry. This powerful and efficient motor does not have a commutator or brushes, which makes it reliable and relatively maintenance-free. However, it has certain drawbacks, which can be overcome by the permanent magnet (PM) AC motor.

PM motors only became competitors to IMs in the 1980s with the creation of a new generation of permanent magnets based on rare-earth elements (REEs) such as neodymium iron boron (NdFeB). (Note that such motors need sophist-
In 1967, the Tennessee Valley Authority took delivery of a record-beating 1,300 MW BBC turbogenerator.

Just over 30 years ago, ABB introduced the softstarter. A softstarter reduces the torque to the electric motor as it starts. This reduces voltage drops on networks, minimizes starting currents, eliminates current spikes and allows cabling to be optimized.

In the intervening years, ABB has refined the softstarter concept with new models continually released to the market. 2010 saw the introduction of the very successful PSE model; in 2014 the PSTX offered new communication features and a new operator interface that gives diagnostic information.

The direct approach
Around the same time that ASEA and BBC came into existence, the War of Currents was taking place. This pitted Edison’s established direct current (DC) technology against the new alternating current.
Over the last 30 years, ABB has made significant technical progress in HVDC cables – for instance, with a 525 kV extruded cable system, launched in 2014, that is based on high-quality cross-linked polyethylene (XLPE). ABB has also developed a dynamic cable structure for HVDC – especially useful for offshore platforms.

**Hybrid breakers**

HVDC systems have to be disconnected if a fault arises. Today’s HVDC installations are mostly point-to-point and can be disconnected by AC breakers at each end. However, this means the entire line is dropped. Once HVDC grids become commonplace, a fault could cause the entire grid to be dropped. A further complication is that disconnection has to happen much more quickly in a HVDC system than in a corresponding AC system.

These factors provided the motivation for ABB to develop its hybrid breaker. Once again, the benefits of power semiconductors were exploited: The ABB hybrid circuit breaker consists of a main breaker built of power electronic switches and surge arresters, and a parallel branch containing an ultrafast disconnector (UFD) and power electronic load commutating switch. This “hybrid” allows fast disconnection suitable for HVDC system applications.

**Automation**

Power is one pillar of ABB technology; automation is the other. It is no exaggeration to say that advances made by ABB changed the face of industrial automation. Not only did the company produce innovations in digital control systems (DCSs) and plant automation but ASEA was responsible for the world’s first commercially successful electrical industrial robot, in 1973.

Early attempts at robotics by others, in the 1950s and 1960s, had resulted in clumsy, noisy, hydraulic beasts that

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**4 A novelty in 1919: An electric locomotive for the Gotthard Tunnel line on a test drive at Thun, Switzerland.**
leaked copious amounts of oil. In the early 1970s, ASEA recognized the potential of electrically driven robots and proceeded to develop and market the world’s first – the IRB 6 (Industrial RoBot/6 kg pay-load). As soon as it appeared, the IRB 6 was a success. The first order was to a small Swedish company and four of the five they ordered are still working in the same place, doing the same job, more than 40 years later – a testimony to the excellent design.

Following on from the IRB 6, whole new generations of ABB robots have been developed for automation tasks in many different industries.

**Continued innovation all around the world**

ABB’s power and automation technology has been inspired by challenges in all possible spheres – in homes and offices, oil and gas fields in remote deserts, water treatment plants, underground in mines, deep beneath the sea (with transformers that work at depths of 3,000 m, for instance), in crowded, cramped cities, in fields and in manufacturing and processing plants that have changed beyond all recognition in recent years. ABB technology is even circling the globe in a satellite.

A significant new area of challenge – one that would not have been foreseen by Brown, Boveri or Fredholm – is climate change. The intellectual energy now being devoted toward mitigating anthropogenic effects on climate has created entirely new areas of innovation for ABB.

Renewable energy is one such area. Wind, solar, biomass, and other forms of generation have challenged ABB to come up with power and automation solutions.

In addition to the generators themselves, distributed renewable power generation and its attendant technologies – such as microgrids, energy storage, load balancing, power conditioning, marketing, scheduling and so on – are other areas that have seen the effects of ABB innovation.

Since the merger of ASEA and BBC in 1988 to form ABB, the company has retained technology and market leadership in many areas by continued innovation in power and automation. Many of the benefits of modern life were made possible by the efforts of ABB researchers over the past 125 years.

**5 The unique SynRM rotor**

Dominic Siegrist
ABB Switzerland
Zurich, Switzerland
dominic.siegrist@ch.abb.com

The key HVDC technology developed by ABB was the series connection of insulated-gate bipolar transistor (IGBT) press-packs.